

University of Mumbai

वेबसाईट - mu.ac.in

ईमेल - आयडी - dr.aams@fort.mu.ac.in
aams3@mu.ac.in



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

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

मुंबई - ४०० ०३२
२७ मे, २०२५


(डॉ. प्रसाद कारंडे)
कुलसचिव

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1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
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3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
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10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
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2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

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3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW directr@dsd.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

As Per NEP 2020

University of Mumbai



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

Name of the Programme –B.E. (Mechatronics Engineering)

Faculty of Engineering

Board of Studies in Mechanical Engineering

U.G. Second Year Programme

**Exit
Degree**

**U.G. Diploma in
Mechatronics
Engineering**

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>Mechatronics Engineering</u>)
2	Exit Degree	U.G. Diploma in <u>Mechatronics Engineering.</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-585C R. TEU-585D	Attached herewith
6	Semesters	Sem. III
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-
Dr. S. M. Khot
BoS-Chairman-Mechanical Engineering
Faculty of Technology

Sd/-
Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-
Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Preamble

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

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the Mechatronics Engineering 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 Mechatronics Engineering 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 Mechatronics 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 2024-25. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2025-26, and 2026-27, respectively.

**Sd/
Dr. S.M. Khot
BoS-Chairman-Mechanical Engineering
Faculty of Technology**

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Associate Dean
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**-Sd/-
Prof. Shivram S. Garje
Dean
Faculty of Science & Technology**

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

	R. TEU-585C									
Level	Semester	Major		Minor	OE	VSC,SEC (VSEC)	AEC, VEC, IKS	OJT, FP,CE P, CC,RP	Cum.C r. / Sem.	Degree/Cu m.Cr.
		Mandatory	Electives							
5.0	III	2413111 2413112 2413113 2413114 2413115 2413116	--	--	OE:2	--	VEC:2 HSL: 2	CEP:2	22	UG Diploma45
	R. TEU-585D									
	IV	2414111 2414112 2414113 2414114 2414115	--	MDM: 4	OE:2	VSEC:2	VEC:2 EEM:2	--	23	
	CumCr.	25	--	4	4	2	2+2+2+2	2	45	

Exitoption: 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 8 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.

**Mechatronics
Engineering
Scheme**

Program Structure for Second Year of Mechatronics 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
2413111	Engineering Mathematics III	2	--	1-	2	1	--	3
2413112	Electronics and Digital Circuit Design	3	--	--	3	--	--	3
2413113	Engineering Materials	3	--	--	3	--	--	3
2413114	Theory of Machines	3	--	--	3	--	--	3
2413311	To be taken from the bucket provided by the University from other Faculty	2#	--	--	2	--	--	2
2413115	Electrical and Electronics Workshop	--	2	--	--	--	1	1
2413116	CAD Modeling Lab	--	2	--	--	--	1	1
2413611	Mini Project (group project)	--	2*+2	--	--	--	2	2
2413511	Entrepreneurship Development (Syllabus common to all Branches).	--	2*+2	---	--	--	2	2
2413512	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)					
2413111	Engineering Mathematics III	20	20	40	60	2	25	--	125
2413112	Electronics and Digital Circuit Design	20	20	40	60	2	--	--	100
2413113	Engineering Materials	20	20	40	60	2	--	--	100
2413114	Theory of Machines	20	20	40	60	2	--	--	100
2413311	To be taken from the bucket provided by the University from other Faculty	20	20	40	60	2	--	--	100
2413115	Electrical and Electronics Workshop	--	--	--	--	--	25	25	50
2413116	CAD Modeling Lab	--	--	--	--	--	25	25	50
2413611	Mini Project (group project)	--	--	--	--	--	50	25	75
2413511	Entrepreneurship Development (Syllabus common to all Branches).	--	--	--	--	--	50	--	50
2413512	Environmental Science for Engineers (Syllabus common to all Branches).	--	--	--	--	--	50	--	50
Total		100	100	200	300	10	225	75	800

Vertical –1 Major

Detail Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413111	Engineering Mathematics III	2	-	1	2	-	1	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2413111	Engineering Mathematics III	20	20	40	60	2	--	--	100

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

Rationale:.

Including Engineering Mathematics III in the Semester 3 syllabus of Mechatronics Engineering is essential for developing advanced analytical skills required for solving complex engineering problems. This subject introduces key mathematical tools such as Laplace and Inverse Laplace transforms, crucial for modeling and analyzing control systems, signals, and dynamic systems. The study of Fourier series aids in understanding signal processing and vibration analysis. Concepts of complex variables and Cauchy-Riemann equations support fluid mechanics and electromagnetics. Matrix algebra and numerical methods equip students with techniques to solve systems of equations, perform transformations, and handle large data sets efficiently

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
01	Module: Laplace Transform 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace Transform (L) of Standard Functions like t , $i(t)$, $o(t)$, $ih(t)$, $oh(t)$ and $t, hr \geq 0$. 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
	Total Hours	26	

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

- 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.

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	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413112	Electronics and Digital Circuit Design	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2413112	Electronics and Digital Circuit Design	20	20	40	60	2	--	--	100

Rationale:

This course is designed to provide students with a comprehensive understanding of the fundamental concepts and principles of electrical and electronics engineering. It focuses on essential topics such as semiconductor devices, digital logic design, and number systems, which serve as the foundation for more advanced studies in electrical and electronic engineering fields. By equipping students with the theoretical knowledge and practical applications of these principles, the course aims to develop critical thinking and problem-solving skills necessary for modern electrical and electronic systems design.

Course Objectives: The course aims

- 1 To study working operation of transistors
- 2 To understand different biasing techniques of transistors
- 3 To learn different applications of transistors
- 4 To study various number systems, their conversion and arithmetic operations
- 5 To learn the fundamentals of digital logic design
- 6 To conceptualize data representation techniques

Course Outcomes: On successful completion of course, student will be able to:

1. Describe working of BJT in different biasing modes and its applications- L1, L2
2. Conceptualize operation of FET and their applications- L1, L2
3. Practice different number systems and their arithmetic operations – L3
4. Design and analyze combinational logic circuits- L4, L6
5. Design and describe sequential logic circuits – L2, L6
6. Represent and evaluate integer and floating point data- L2, L5

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of Electrical Engineering; Fundamentals of Electronics Principles	2	
I	BJT	BJT construction; BJT operation; BJT Configurations and characteristics- Common Base, Common Emitter and Common Collector; Transistor Biasing: Need of biasing; Voltage divider bias configuration; Common base configuration; Applications: BJT as a switch; BJT as an amplifier	7	1

II	FET	Junction Field Effect Transistor (JFET): Construction, operation and characteristics; transfer characteristics; Application: JFET as switch; JFET as an amplifier; Metal-Oxide Effect Transistor (MOSFET): Construction, Operation and Characteristics of Depletion & Enhancement type MOSFET; Application: MOSFET as a switch in CMOS inverter	7	2
III	Number Systems	Introduction to Number systems; Binary, Octal, Decimal and Hexadecimal number systems and their conversions; Signed Binary Numbers- 1's and 2's complement; Binary subtraction using 2's complement; Binary Code: Binary Coded Decimal, Gray Code, ASCII code and their conversions	4	3
IV	Combinational Logic Circuits	NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR Gates; NAND and NOR as a universal logic gates; Sum of products and products of sum form; Reduction of Boolean functions using K6-map method (2,3,4 Variable) and Realization using gates; Design of Half & Full Adder; Half & Full subtractor; Multiplexers & Demultiplexers; Encoders & Decoders; Comparator; Analysis of combinational logic circuits	8	4
V	Sequential Logic Circuits	NAND based SR latch; NAND based SR, D, JK, T and Master-slave JK Flip-Flops and their function table; Conversion of flip flops; Shift registers; Universal Shift Register; Design and analysis of asynchronous & synchronous up, down and up-down Counters; Mod Counters; Ring Counters	8	5
VI	Data Representation	Basics of floating-point representation; IEEE 754 floating point (Single & double precision) number representation.	3	6

Text Books:

1. Electronic Devices and Circuit Theory by Robert Boylestad & Louis Nashelsky, 11th Edition, Pearson Education
2. Modern Digital Electronics by R. P. Jain, 4th Edition, McGraw Hill Education

References:

1. Electronic Circuits: Analysis and Design by Donald A. Neamen, 3rd Edition, McGraw Hill Education
2. Electronic Principles by Albert Paul Malvino, David J. Bates & Patrick E. Hoppe, 9th Edition, McGraw Hill Education
3. Digital Design by M. Morris Mano, 6th Edition, Pearson Education
4. Fundamentals of Digital Circuits by A. Anandkumar, 4th Edition, PHI
5. Digital: Principles and applications by Leach, Malvino & Saha, 8th Edition, McGraw Hill Education

Online References:

1. <https://nptel.ac.in/courses/108101091>
2. <https://nptel.ac.in/courses/117106114>
3. <https://nptel.ac.in/courses/117103063>

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
- Give proportionate weightage to each chapter based on number of hours allotted.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413113	Engineering Materials	3	-	-	3	-	-	3

	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2413113	Engineering Materials	20	20	40	60	2	--	--	100

Rationale

:

Engineering Materials and Metallurgy in Semester 3 equips Mechatronics Engineering students with essential knowledge of material properties, behavior, and selection. Topics like crystal structures, alloys, heat treatment, ceramics, polymers, and composites support informed design choices. Understanding fracture, fatigue, and creep aids in predicting failures, while exposure to electronic, photonic, and nano-structured materials encourages innovation in sensors and smart systems. This subject builds a strong foundation for reliable, high-performance, and modern mechatronic applications across diverse industries

Course Objectives: Six Course Objectives

1. To emphasis on the importance of materials for emerging technologies
2. To prepare the students with knowledge of basic engineering materials, their properties and their applications.
3. To acquaint the students with the concepts of Nanomaterials
4. To prepare the students acquire basic understanding of advanced materials, their functions and properties for technological applications.
5. To familiarize the students with various types and causes of failure of components in different engineering applications.

Course Outcomes: Students will be able to:

- 1) Identify the various classes of materials and comprehend their properties
- 2) Apply phase diagram concepts to engineering applications and suggest particular heat treatment for required property development
- 3) Suggest newer materials for conventional and modern applications
- 4) Identify the probable mode of failure in materials and suggest measures to prevent them
- 5) Compare and contrast electronic and magnetic materials
- 6) Apply smart materials as well as nanomaterials for different applications

Prerequisite: Applied Chemistry, Applied Physics

Module	Detailed Contents	Hrs.	CO
01	1.1 Introduction: Classification of materials, functional classification and classification based on structure. 1.2 Crystal Structure: Crystal, Crystal lattice, crystal system, Bravais space lattices, Types of cubic crystal, crystal directions, crystal planes, Miller indices, Interplanar spacing, planar density. 1.3 Crystal Imperfection: point, line, surface defects and volume imperfection. Role of dislocations in deformation and strengthening. Effect of grain boundaries on mechanical properties of materials.	6	CO1
02	2.1 Classification of Alloys based on phases and phase diagram: Solid solutions and intermediate phases, Binary alloy phase diagram – Isomorphous, Eutectics type I and II, Peritectic. The Iron-Iron Carbide Phase Diagram. Classification of Plain Carbon Steels and Cast Irons. Effect of alloying elements in steels. TTT diagram & CCT diagram. 2.2 Heat Treatment: Annealing, normalizing, tempering, hardening and surface-case hardening processes. 2.3 Powder Metallurgy: Powder Metallurgy Process. Applications such as oil impregnated Bearings and Cemented Carbides. Limitations of Powder Metallurgy.	10	CO2
03	3.1 Ceramics: Definition, comparative study of structure and properties of Engineering Ceramics with reference to metallic materials. Engineering application of Ceramics. 3.2 Polymers: Classification of polymers. Thermoplastics, effect of temperature on thermoplastics, mechanical properties of thermoplastics. Thermosetting polymers. 3.3 Composites: Definition; Classification; Particle-reinforced composites and fibre-reinforced composites. Rule of mixtures; Sandwich structures. Classification of composites on basis of matrix materials.	7	CO3
04	4.1 Fracture: Definition and types of fracture. Brittle fracture and Ductile fracture. Ductility transition. 4.2 Fatigue Failure: Definition of fatigue and significance of cyclic stress. Mechanism of fatigue. S.N. Curve and its interpretation. Influence of important factors on fatigue. 4.3 Creep: Definition and significance of creep. Effect of temperature and creep on mechanical behaviour of materials.	4	CO4
05	5.1 Electronic Materials: Band structure of solids. Conductivity of metals and alloys. Semiconductors and superconducting materials. Insulators and dielectric properties. 5.2 Photonic Materials: Refraction, reflection, absorption and transmission. Luminescence, Photoconductivity, Lasers, optical fibres in communications. 5.3 Magnetic Materials: classification of magnetic materials. Diamagnetic, paramagnetic, ferromagnetic, ferromagnetic and super paramagnetic materials. Metallic and ceramic magnetic materials. Applications of magnetic materials.	6	CO5

DETAILED SYLLABUS:

06	6.1 Nano-structured Materials: Definition and Introduction to nanotechnology. Unique features of nano-structured materials. Typical applications. 6.2 Modern Engineering Materials: Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses.	6	CO6
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Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I) consisting of **20 marks each**. Duration of each test shall be one hour.

End Semester Theory Examination for 60 marks:

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

Text Books:

1. Callister's Materials Science and Engineering, 2nd edition by R. Balasubramaniam, Wiley India Pvt. Ltd
2. Introduction to Engineering Materials, B K Agrawal, Tata Mcgraw Hill
3. Materials Science and Engineering : A First Course, Raghavan V , Prentice Hall India
4. MATERIAL SCIENCE AND METALLURGY FOR ENGINEERS by Dr. V.D Kodgire and S.V Kodgire. Everest Publishing House

References:

1. Introduction to Physical Metallurgy, Sidney H. Avner, Tata Mcgraw Hill
2. Introduction to Materials Science for Engineers; 8th Edition by James F. Shackelford Pearson
3. The Science and Engineering of Materials (6 th Edition), by Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, Cengage Learning, Inc., Stanford, USA., (2010)
4. Materials Science and Engineering, 5th edition by V. Raghavan, Prentice Hall India
5. R. A. Higgins ENGINEERING METALLURGY Part I R.A. Higgins (Higgins, Raymond A.
6. A Text Book of Nanoscience and Nanotechnology, by Pradeep. T, Tata McGraw Hill, New Delhi, (2012).
7. Electronic Properties of Materials (4th Edition), by Rolf E. Hummel, Springer, New York, (2011).
8. Photonic Crystals: Theory, Applications, and Fabrication, by Dennis W Prather, John Wiley & Sons, Hoboken, (2009).
9. SPRINGER HANDBOOK OF ELECTRONIC AND PHOTONIC MATERIALS

Links:

1. [NPTEL :: Mechanical Engineering - NOC:Smart Materials and Intelligent System Design](#)
2. [NPTEL :: Metallurgy and Material Science - NOC:Introduction to Materials Science and Engineering](#)
3. <https://youtu.be/-wcqPMw8N1Y>
4. <https://youtu.be/-wcqPMw8N1Y>

Online References:

Sr. No.	Website Name
1.	https://iisc.ac.in/outreach/publications/iisc-lecture-notes-series/
2.	https://www.usna.edu/NAOE/files/documents/Courses/EN380/Course_Notes/Ch1_1_Fracture.pdf
3.	https://ocw.mit.edu/courses/3-012-fundamentals-of-materials-science-fall-2005/pages/lecture-notes/
4.	Electronic, Optical and Magnetic Properties of Materials Materials Science and Engineering MIT OpenCourseWare

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413114	Theory of Machines	3		-	3		-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2413114	Theory of Machines	20	20	40	60	2	--	--	100

Rationale

This subject introduces students to the fundamentals of kinematics, enabling them to analyze and understand the motion of machine elements. By studying motion and power transmission elements, students gain practical insights into gears, cams, belts, and chains, which are crucial for mechanical system integration. Additionally, learning the working principles of governors and gyroscopes helps in understanding control, stability, and navigation. This subject strengthens the mechanical core of mechatronics and supports multidisciplinary design and innovation.

Course Objectives:

1. To acquaint with basic concept of kinematics of machine elements
2. To familiarize with basic and special mechanisms
3. To study the functioning of motion transmission machine elements
4. To study the functioning of power transmission machine elements
5. To acquaint with working principles and applications of Governors
6. To acquaint with working principles and applications of Gyroscope

Course Outcomes:

1. Identify various components of mechanisms and develop mechanisms to provide specific motion
2. Draw and analyze velocity and acceleration diagrams for various mechanisms
3. Development of cam profile for the specific follower motion.
4. Predict conditions for maximum power transmission in the case of a belt drive
5. Illustrate requirements for an interference-free gear pair
6. Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Basic Kinematics Kinematic link & its types, Kinematic pairs, Types of Kinematic pairs, Kinematic chains, Types of constrained motions, Mechanism, Machine, Structure, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Gröbler's criterion & its limitations. Four bar chain and its inversions, Slider crank chain and its inversions, Double slider crank chain and its inversions. Hooks Joint (Single and double)	06	1
II	Velocity and Acceleration Analysis	Velocity Analysis of Mechanisms (mechanisms up to 6 links) 2.1 Velocity analysis by relative velocity method (Graphical approach) 2.2 Acceleration Analysis of Mechanisms (mechanisms up to 6 links) Acceleration analysis by relative method (Graphical approach).	08	2
III	Cam and Follower Mechanism	3.1 Cam and follower; Classification Cam and follower terminology; 3.2 Motions of the follower: Uniform Velocity, SHM, Constant acceleration and deceleration (parabolic), Cycloidal (Displacement, Velocity and acceleration Plots)	06	3
IV	Power Transmission	Power Transmission Belts, Chains: 4.1 Belts: Introduction, Types, Dynamic analysis –belt tensions, condition of maximum power transmission 4.2 Chains: Introduction to Chain Drives, Classification of chains, length of chain. Types of brakes Introduction and Classification.(No Numerical)	06	5
V	Gears	Gears: Law of gearing, Forms of tooth, Details of gear terminology, Path of contact, Arc of contact, Contact ratio, Interference in involutes gears, Minimum number of teeth for interference free motion	06	5
VI	Governors and Gyroscopes	6.1 Governors: Introduction to Centrifugal and Inertia governors, Study and Force analysis of Porter and Hartnell governors. 6.2 Gyroscope: Introduction, Gyroscopic couple and its effect on spinning bodies, naval ship during steering, pitching, rolling and their stabilization.	08	6

Text Books:

1. S.S. Ratan, "Theory of Machines", Tata McGraw Hill
2. Ghosh and A.K. Mallik, "Theory of Mechanisms and Machines", East-West Press
3. Theory of Machines by Jagdish Lal Metropolitan Book New Delhi, Company, Daryaganj, Delhi

References:

1. J.J. Uicker, G.R. Pennock, and J.E. Shigley, "Theory of Machines and Mechanism", Oxford Higher Education
2. P.L. Ballaney, "Theory of Machines", Khanna Publishers
3. M.A. Mostafa, "Mechanics of Machinery", CRC Press
4. R.L. Norton, "Kinematics and Dynamics of Machinery", McGraw Hill
5. A.G. Erdman, G.N. Sander, and S. Kota, "Mechanism Design: Analysis and Synthesis Vol I", Pearson
6. Theory of Machines Thomas Bevan CSB Publishers & Distributor

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112/105/112105268/
2.	https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obOzOhJLRt
3.	http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

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:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- Question paper will comprise of total six questions, **each carrying 20 marks**
- **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
- **Remaining questions** will be **mixed in nature** (for example if Q.2 has part(a) from module 3 then part (b) will be from any module other than module 3)
- A total of **three question** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413115	Electrical and Electronics Workshop	-	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				
2413115	Electrical and Electronics Workshop	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce the basic laboratory instruments (eg. CRO, Signal Generator, Multimeter etc) and Circuit Elements (eg. Resistor, Capacitor, Inductor)
2. To introduce household electrical & electronic equipments and wiring system
3. To introduce Computer hardware.
4. To design PCB and develop small circuit
5. To introduce speed control of DC Motors and IM
6. To introduce In-Circuit and Function testing of PCB

Lab Outcomes:

- 1) Understand working of different lab equipment & Demonstrate skills in handling electrical components
- 2) Repair and do maintenance of household appliances.
- 3) Understand working of different parts of Computer
- 4) Demonstrate PCB design and soldering skills
- 5) Implement speed control of DC Motors / IM
- 6) Explain In-Circuit and Function Testing fixtures in PCB mass production.

Prerequisite:
BSC102: Applied Physics
ESC102: Basic Electrical and Electronics Engineering
VSEC101: Engineering Workshop I
VSEC201: Engineering Workshop II

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Revision of electrical circuits, Semiconductor and Engineering workshop	–	–
I	Examination of the construction and operation of various lab equipment	Introduction to different equipment in the lab (multi-meter, CRO, DSO, power supplies, function generators); Resistors, presets, potentiometers, inductors (iron core and ferrite core), capacitors of different ratings.	02	LO1
II	Introduction to Household electrical System and equipments	Wiring materials, selection of wire, different switching and protection. Repair of household appliances and machines: Testing, fault finding, Dismantling, assembling.	02	LO2
III	Introduction to Computer hardware.	Functional block diagram, unmounting computer CPU, study internal structure of Computer parts.	02	LO3
IV	Hardware implementation of Electronics circuits	Soldering techniques and equipment, PCB Layout (artwork) design using software and Fabrication etching process. Testing and debugging process of assembled circuits. Making small Switching circuits using electronic components.	02	LO4
V	Introduction of DC Motors & Single phase IM	Working Principle and practical applications of Machines with speed control methods	04	LO5
VI	Electronic component testing using microcontroller based multifunction tester.	Identification and characterization of various electronic components (Transistors, Capacitors etc) using automated microcontroller based multifunction tester.	02	LO6

References:

1. J. B. Gupta “Electrical Installation Estimating & costing” S. K. Kataria & Sons, 2009
2. K.B. Raina, S.K. Bhattacharya “Electrical Design Estimating and Costing”, New Age Inter. 2018
3. Alagappan N. & Ekambaram S. Electrical Estimating & costing Tata McGraw hill Ltd.
4. S.L. Uppal and G.C. Garg “Electrical Wiring Estimating and Costing” Khanna Publishers 1987
5. Surjit Singh “Electric Estimating and Costing” Dhanpat Rai & Co. (P) Limited (2016)
6. K B. Bhatia “Study of Electrical Appliances and Devices” Khanna Publishers
7. John T. Bateson “In Circuit Testing” Springer 2012
5. K B. Bhatia “Study of Electrical Appliances and Devices” Khanna Publishers
6. Bimbhra P. S., Electric Machinery, Khanna Publisher,
7. Karl-Heinz Kubbelier “Transistor Tester with AVR microcontroller. A device for determining and measuring electronic components and a little more” .Version 1.13k March 20, 2021

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/122/106/122106025/
2.	https://nptel.ac.in/courses/108/101/108101091/
3	https://swayam.gov.in/nd2_aic20_sp59/
4	https://nptel.ac.in/courses/108/108/108108076/

List of Experiments.

Sr No	List of Experiments	Hrs
01	Examine construction and operation of different lab equipment & Components. Behavior of RLC circuits	
02	Introduction to household electrical wiring.	
04	Repair of house hold appliances and machines (Fan)	
05	Speed control methods of DC Motor / IM	
06	Assembly and disassembly of computer hardware.	
07	Hardware implementation of electronic circuits	
08	Electronic component testing using microcontroller based multifunction tester	
09	Circuit simulation of simple circuits on simulation software	

Assessment :**Part B**

One compulsory visit to any Electrical Machines or Electronics Equipments Manufacturing Industry

Term Work: It comprises both part A and B

Term Work shall consist of at least 8 practicals' based on the above list.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Industrial Visit Report) + 5 Marks (Attendance)

End Semester Examination: Pair of Internal and External Examiner should conduct Oral on the entire syllabus of the laboratory.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413116	CAD Modeling 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				
2413116	CAD Modeling Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize geometric modelling techniques
2. To impart 2D sketching skills using CAD software
3. To impart the 3D Solid and Surface Modelling skills for the development of 3D models of engineering components.
4. To impart Geometric Dimensioning and Tolerance skills
5. To impart the 3D modelling skills for assembling different parts made in 3D modelling software.
6. To introduce Product data exchange among CAD systems.

Lab Outcomes:

Learner will be able to...

7. Use appropriate technique for geometric modelling.
8. Apply 2D sketching tools to prepare sketch of a given object using 3D CAD software.
9. Create solid and Surface model of the object using 3D CAD software.
10. Apply Geometric Dimensioning and Tolerancing (GD&T) for working drawing of parts.
11. Generate assembly of given objects using assembly tools of a 3D CAD software
12. Use product data exchange formats to perform product data exchange among CAD systems.

Prerequisite:

1. ESL201: Engineering Graphics laboratory
2. PLC 303: Working Drawing – GD & T laboratory

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO (Lab Outcomes) Mapping
0	Prerequisite			
I	Introduction to CAD	Different modelling techniques (solid modelling, surface modelling, parametric modelling, feature based modelling) for creation of CAD models, creation of CAD models from different perspectives.	02	1
II	Sketching using 2D sketch tools	Setting the sketch environment, creating sketch from a geometry using the sketching commands like- line, circle, arc, etc., modification in sketches using commands like- move, trim, rotate, etc.), use of viewing commands like- pan, zoom, rotate, etc., use of sketch constraints.	04	2

III	Solid Modelling	Settings environment for part modeling, creating machine/engineering parts/components using features like – extrude, revolve, mirror, threading, fillet, hole, bend, rib, patterns (rectangular, circular, etc.), etc. Introduction to surface modeling.	06	3
IV	Working Drawings	Creating Multi-view Drawings from 3D CAD Models: part drawings with tolerance Geometric Dimensioning and Tolerance (GD&T) Dimensioning with tolerances indicating various types of fits, GD&T symbols indicating forms, profile, Orientation, Run out, Location etc.	04	4
V	Assembly	Constraints, exploded views, interference check, drafting (layouts, standard & sectional views, detailing & plotting), use of transformations and manipulation commands (translate, rotate, scale, etc.) to modify and assemble the created CAD models.	08	5
VI	Data Exchange	CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability.	02	6

Textbooks:

1. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
2. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication

References:

1. Machine Drawing by N.D. Bhatt.
2. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
3. Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection A Handbook for Geometrical Product Specification using ISO and ASME Standards Second edition Georg Henzold 2006

List of Experiments.

Sr No	List of Exercises	Hrs
01	3D modeling of basic Engineering components like - Nuts, Bolts, Keys, cotter, Screws, Springs etc. (Note: Any two out of above)	2
02	3D modeling of basic machine components like - Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts. (Note: Any two out of above)	10
03	Working drawing of Mechanical component showing Form, Profile, Orientation, Runout and location using GD&T Symbols. (Note: Any Two Drawings)	4
04	1) Generation of an assembly model (minimum five child parts) along with working (production) drawing of the system, creation of 3D models with assembly constraints, interference check, exploded view, GD&T, tolerance table and fit table, bill of material. OR 2) Reverse Engineering of a physical model: disassembling of physical model having not less than five parts, measuring the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions (Note: Any one of above)	10

Using the knowledge and skills acquired through six modules, students should complete minimum seven assignments/experiments from the given sets of assignments using standard CAD modeler like – SolidWorks/ PTC Creo/CATIA /UG /any other suitable software.

Assessment:

Term Work: Term Work shall consist of at least 7 practicals based on the above list. Also, Term work Journal must include at least 7 exercises (prints) as mentioned above.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment/Assignments) + 5 Marks (Attendance)

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

SEC

Vertical – 5

Detailed syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413511	Entrepreneurship Development		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				
2413511	Entrepreneurship Development	--	--	--	--	50	--	50

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

Lab Objectives:

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

Lab Outcomes:

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

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

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.	01	--
I	Introduction to Entrepreneurship	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	02	LO1
II	Business Idea Generation & Validation	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	04	LO2

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

Text Books:

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

References:

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

Online Resources:

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

List of Experiments.

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

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

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

Assessment :

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

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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2413512	Environmental Science		2*+2	-	-	2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I+IAT-II					
2413512	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:

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

DETAILED SYLLABUS:

Unit Name	Topic Name	Topic Description	Hours	LO Mapping
I	The Multidisciplinary Nature of Environmental Studies	Definition, scope and importance. Need for public awareness, Role of information technology in environment and human health. Human population and the environment: Population growth, variation among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare	03	LO1

II	Natural Resources	Renewable and non-renewable resources. Natural resources & associated problems: a) Forest resources: b) Water resources: Natural resources & associated problems c) Mineral resources: d) Food resources: e) Energy resources: Role of an individual in conservation of natural resources: f) Equitable use of resources for sustainable lifestyles.	04	LO2
III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries). Case study on various ecosystems in India.	05	LO3
IV	Biodiversity and its Conservation	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	05	LO4
V	Environmental Pollution Definition	Causes, effects and control measures of: a) Air pollution b) Water pollution c) Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Case study on Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	05	LO5
VI	Social Issues and Environment	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solution. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Consumerism and waste products. Environment protection act. Public awareness Case study on Environmental Ethics	04	LO6

Textbooks

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021
2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016

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

Reference Books

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

Online References:

Sr. No.	Website Name
4.	Centre for Science and Environment (CSE), Website: cseindia.org
5.	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)

Letter Grades and Grade Points:

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

Sd/-

Dr. S. M. Khot
BoS-Chairman-Information Technology
Faculty of Technology

Sd/-

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-

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