Shree Rahul Education Society's (Regd.)

Shree L.R. Tiwari College of Engineering

Shree L.R. Tiwari Educational Campus, Mira Road–East, Thane-401 107.Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Electronics and Computer Science

A.Y 2025-26

Second Year: Semester III

Prepared by: Board of Studies for Electronics and Computer Science

Approved By: Academic Council of Shree L.R. Tiwari College of Engineering

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class centre for socio- economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mind-set essential for success in today's evolving professional landscape.

1. **Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented the autonomous curriculum adopts a bottom-up, learner-concentric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socioeconomic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.**
2. **Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impact solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.**
3. **Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.**
4. **Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.**
5. **Empowering Faculty as Mentors and Innovators SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.**

Sincerely,

IQAC Chairperson
SLRTCE

COO
Rahul Education

PREFACE FROM CHAIRPERSON (BOS)

Dear Colleagues and Esteemed Members of the Board,

It is my pleasure to present the newly revised Electronics and Computer Science curriculum—crafted under our recently granted Autonomous status and in compliance with NEP 2020 Building upon the strong foundational framework of SLRTCE's legacy—where industry-oriented, tools-based learning complements core computing principles—this syllabus ushers in a truly student-centric, flexible, and future-ready program.

The Electronics and Computer Science (ECS) program at our autonomous institute under Mumbai University is a forward-looking, interdisciplinary course that combines the robust foundations of electronics with the transformative capabilities of computer science. The program equips students with the knowledge and skills needed to design, develop, and optimize intelligent systems, enabling innovation at the intersection of hardware and software.

As an autonomous institution, we utilize academic independence to continuously update and enrich the curriculum to reflect emerging technologies and industry demands, including areas such as Internet of Things (IoT), artificial intelligence, embedded systems, robotics, and cyber-physical systems.

A key feature of the program is the integration of the Idea Lab, a dynamic innovation ecosystem where students engage in hands-on, project-based learning. This lab nurtures creativity, design thinking, and entrepreneurial mindsets, enabling students to take ideas from concept to prototype, often in collaboration with industry, faculty, and the community.

The ECSE program strongly emphasizes societal impact. Students are encouraged to develop technology-driven solutions to address real-world challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs). Whether it is promoting quality education (SDG 4) through ed-tech innovations, enhancing good health and well-being (SDG 3) with biomedical devices, contributing to sustainable cities and communities (SDG 11) through smart systems, or driving climate action (SDG 13) using intelligent environmental monitoring, the curriculum instills a deep sense of purpose and responsibility.

Through a balance of theoretical grounding, practical application, ethical awareness, and social commitment, the ECSE program prepares graduates to become technological leaders, responsible citizens, and agents of sustainable development in a rapidly evolving global landscape.

Mrs. Samita Bhandari
Chairperson, Board of Studies (ECS), SLRTCE

Contents

A. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

B. Academic Brief

1. **Internal Assessment (Formative Assessment):**
   These assessments aim to evaluate students' continuous academic progress. Internal Assessment (IA) will consists of two compulsory Internal Assessment Test of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour. Summation of the two tests will be considered as IA marks. The first IA will be scheduled around the 6th week, and the second IA around the 13th week from the commencement of the semester.
2. **End Semester Examination (60-Marks):**
   i. Question paper will comprise of total 06 questions, each carrying 10 marks
   ii. The questions for 10M will be based on each module of the syllabus.
   iii. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
   iv. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B. Remaining questions will be in similar nature and selected from the respective module.
   v. Total 06 questions need to be attempted.
3. **IDEA Lab Formative Assessment:**
   Monthly formative assessments will be conducted for IDEA Lab activities to monitor creativity, innovation, and problem-solving skill development.
4. **Monthly Defaulter List:**
   A defaulter list identifying students with attendance or academic performance concerns will be prepared and circulated every month.
5. **Defaulter Meeting with Attendance Committee:**
   Students listed as defaulters will meet with the Attendance Committee on the first Saturday of every month.

C. Academic Overview-Semester-III Theme

Theme: "Digital Innovation for Urban Development and Environmental Sustainability"

- **SDG 11: Sustainable Cities and Communities**
- **SDG 9: Industry, Innovation and Infrastructure**
- **SDG 13: Climate Action**
- **SDG 6: Clean Water and Sanitation**
- **SDG 3: Good Health and Well-being**
- **SDG 12: Responsible Consumption and Production**

Keywords: Energy wastage, food waste, rainwater harvesting, traffic management, air pollution.

Description: The theme **"Digital Innovation for Urban Development and Environmental Sustainability"** focuses on leveraging emerging technologies and computational systems to address critical challenges in urban living. Across urban and institutional settings, a range of sustainability challenges persist—from energy wastage in educational campuses like Rahul Education, to unsafe road conditions in municipalities such as Mira-Bhayandar, to excessive food waste in college hostels and canteens. These issues are compounded by underutilized rainwater harvesting in residential buildings, worsening urban traffic congestion, and the silent threat of indoor air pollution due to inadequate monitoring. Despite isolated efforts, a common thread among these problems is the absence of data-driven, scalable solutions that are both cost-effective and easy to implement. Addressing these challenges through smart technology and community engagement can significantly advance multiple UN Sustainable Development Goals, including clean energy, good health, sustainable cities, responsible consumption, and clean water access.

C. Academic Overview-Semester-III Problem Statement

Problem Statements:

1. Rahul Education faces ongoing energy wastage due to lights, fans, and devices being left on unnecessarily across campus buildings. Manual efforts to control usage have been ineffective, leading to higher costs and a larger carbon footprint. A simple, scalable solution is needed to monitor and reduce electricity waste, supporting the institution's sustainability goals. **(UNSD Goal: 7 – Affordable and Clean Energy)**

2. The Mira-Bhayandar Municipal Corporation (MBMC) is facing a critical challenge in managing and maintaining its road infrastructure due to widespread potholes, open manholes, and incomplete road works. These conditions pose significant risks to public safety, causing frequent accidents and disruptions in daily commuting. Despite periodic repair efforts, the lack of a systematic monitoring, reporting, and prioritization mechanism has led to inefficient resolution and repeated infrastructure failures. **(UNSD Goal 9: Industry, Innovation and Infrastructure, Goal 3: Good Health and Well-being)**

3. College hostels and campus canteens frequently face the challenge of excessive food waste due to over-preparation, unpredictable attendance, and lack of planning. This not only leads to significant resource wastage but also contradicts efforts toward sustainable and responsible consumption practices. Despite existing manual efforts to estimate food demand, the absence of a data-driven approach to predict meal requirements and manage surplus food has resulted in repeated wastage. This issue highlights the need for a simple, tech-assisted solution to minimize food leftovers and, where feasible, facilitate timely redistribution to those in need. **(UNSD Goal: 12 – Responsible Consumption and Production)**

4. Urban residential buildings often overlook the use of rooftops for rainwater harvesting, despite recurring water shortages and untapped potential for collection. The absence of simple, cost-effective solutions and public awareness contributes to underutilization, hindering sustainable water conservation efforts. (**UNSD Goal 6 Clean Water and Sanitation)**

5. Urban areas face increasing traffic congestion, leading to longer commute times, increased pollution, fuel consumption, and road accidents. Existing traffic systems are often static, inefficient, and unable to adapt to real-time conditions. There is a growing need for intelligent, real-time traffic management systems that are scalable, cost-effective, and technologically driven. (**UNSD Goal 11: Sustainable Cities and Communities)**

6. Air pollution in urban areas poses serious health risks, especially indoors, where many residents are unaware of the poor air quality due to the absence of affordable monitoring tools**. (UNSD Goal 3: Good Health and Well-being)**

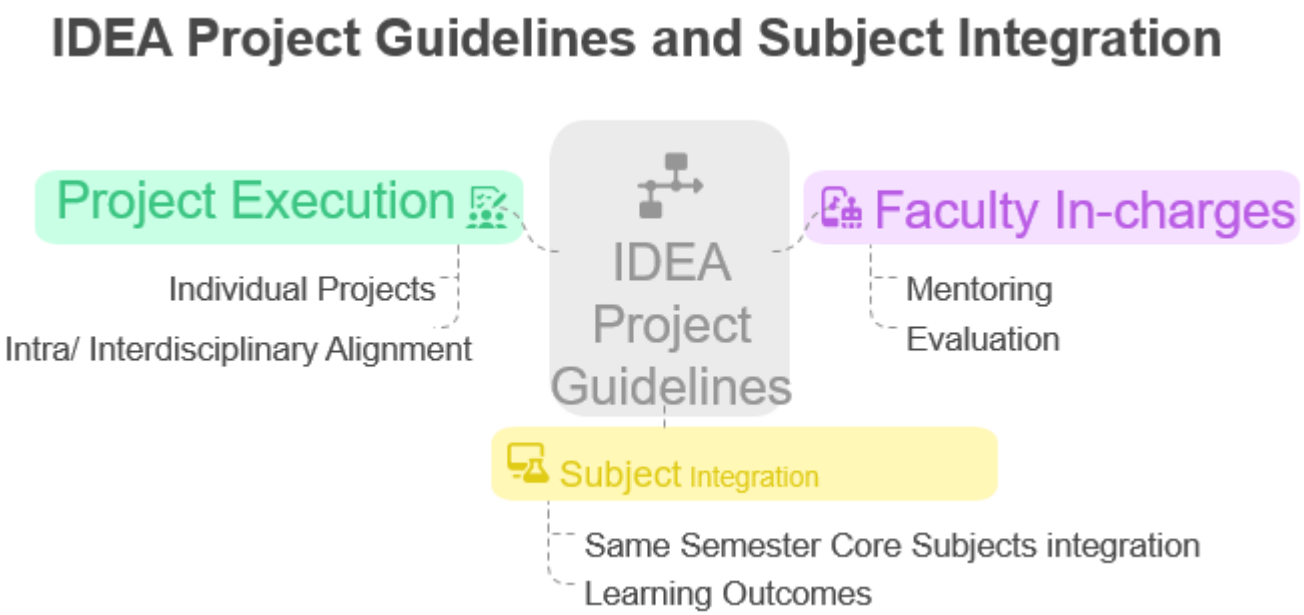
D. Innovation Design Engineering and Apply (IDEA) Lab

1: IDEA Lab: Objectives and Outcomes

The lab bridges the gap between **classroom knowledge and applied innovation**. It nurtures a maker mindset by aligning outcomes with **higher-order thinking**, prototyping, and reflective learning—key goals of NEP-aligned education.

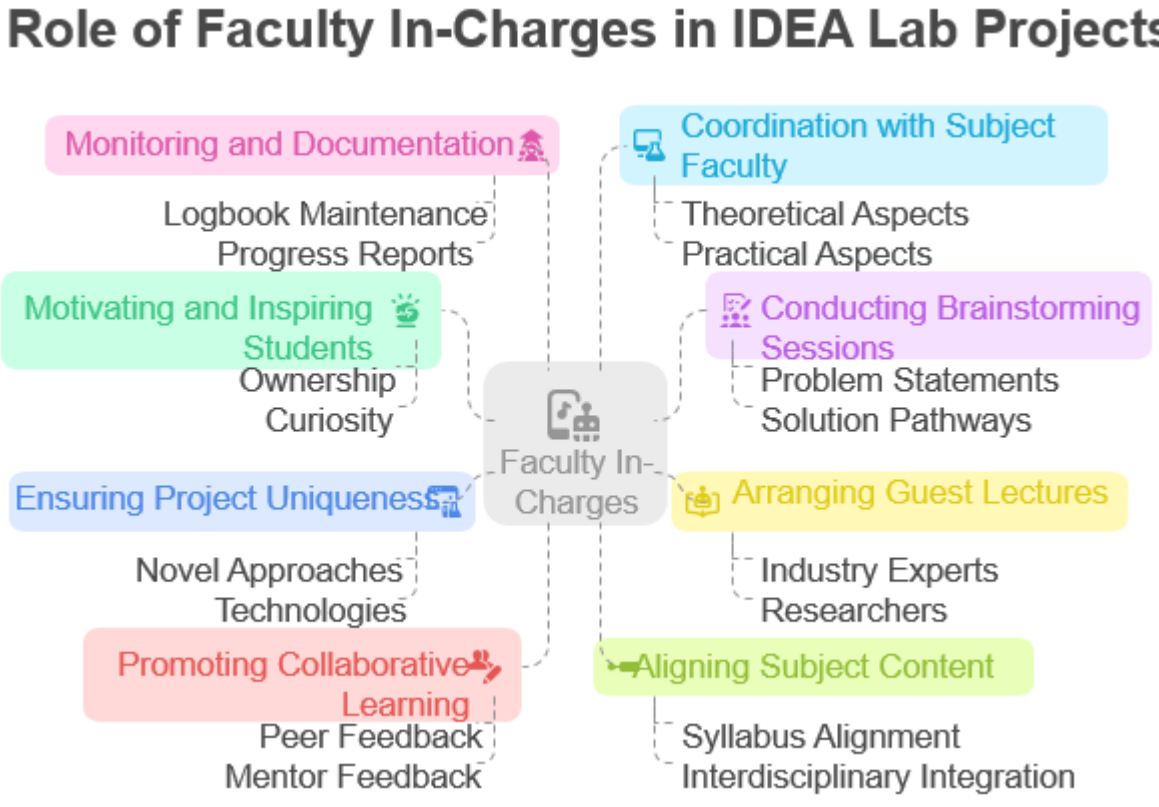
2. IDEA Project Guidelines Comparison

This comparison clarifies the **ecosystem of roles**: students apply interdisciplinary learning; faculty act as academic and innovation guides. Coordination across roles ensures **synergy between syllabus, project outcomes, and real-world relevance**.



3. Faculty In-Charge Implementation Strategies

Faculty implementation is based on a **dual contribution model**: they ensure academic integration through subject mapping and promote innovation via mentoring. The strategy institutionalizes **capacity building, accountability, and interdisciplinary facilitation**.



4. IDEA Lab Project Assessment Criteria

This rubric supports **progressive skill development** across three months—encouraging early ideation, mid-stage feasibility, and final innovation. It integrates **experiential learning and continuous assessment**, fostering critical thinking and ownership, as envisioned in NEP 2020.Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project

Assessment of IDEA Lab Projects (Individual Intra/Interdisciplinary Projects) (25 Marks)

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software /simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

E: Curriculum Structure – SE Semester-III

Table 1: Course-wise Teaching Scheme and Credit Structure

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
13211301	**PCC**	Mathematical Foundations for Electronics and Computer Science	2	1	–	30	15	–	45	90	3
13211302	**PCC**	Electronic Devices and Circuits	3	--	--	45	--	--	45	90	3
13211303	**PCC**	Computer Organization and Architecture	3	--	–	45	--	--	45	90	3
13211304	**PCC**	Data Structures and Algorithms	3	–	–	45	--	--	45	90	3
13212305	**PCCL**	Electronic Devices and Circuit Lab	–	-	2	--	--	30	--	30	1
13212306	**PCCL**	Data Structures and Algorithms Lab.	–	--	2	--	--	30	--	30	1
9951137XX	**OE**	To be selected from the bucket proposed by other institute of Rahul Education	2	-	–	30	--	--	30	60	2
98431308	**Entrepreneur-ship**	Entrepreneurship Development	2	-	–	30	--	--	30	60	2

98451309	**Value Education Course**	Environmental Science	2	-	–	30	--	--	30	60	2
13612310	**Community Engagement Project**	IDEA LAB-III (Innovation Design Engineering and Apply	**1**	**--**	**2***	**15**	**--**	**30**	**15**	**60**	2
Total			**18**	**1**	**6**	**270**	**15**	**90**	**285**	**660**	**22**

Note:

1) CC and AEC will be common to all Branch

2) BSC , ESC and corresponding lab is Department Specific

3) Questions based on self learning must not be asked in internal assessment and End semester Exam

4) * IDEA Lab :The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements.Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. The subject with no termwork and practical will have no assessment on self learning topics. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

F: Examination Scheme – SE Semester-III

Table 2: Course-wise Examination and Evaluation Scheme

Course Code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Pract & Oral	
			IAT-1	IAT-2	Total					
13211301	**PCC**	Mathematical Foundations for Electronics and Computer Science	20	20	40	60	2.5	25	–	125
13211302	**PCC**	Electronic Devices and Circuits	20	20	40	60	2.5	–	–	100
13211303	**PCC**	Computer Organization and Architecture	20	20	40	60	2.5	–	–	100
13211304	**PCC**	Data structures and Algorithms	20	20	40	60	2.5	–	–	100
13212305	**PCCL**	Electronic Devices and circuits Lab	–	–	–	–	–	25	25	50
13212306	**PCCL**	Data Structures and Algorithms Lab.	–	–	–	–	–	25	25	50
9951137XX	**OE**	To be selected from the bucket Rahul Education	–	–	–	–	–	25	–	25
98431308	**Entrepreneur-ship**	Entrepreneurship Development	–	–	–	–	–	25	–	25
98451309	**Value Education Course**	Environmental Science	20	20	40	60	2.5	–	–	100

13612310	**Community Engagement Project**	IDEA LAB - III(Innovation Design Engineering and apply	–	–	–	–	–	50	50	100
		Total	**100**	**100**	**200**	**300**	**12.5**	**175**	**100**	**775**

G. Course Content – Semester III

R-2025- S.E (Sem-III) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
13211301	Mathematical Foundations for Electronics and Computer Science	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211301	Mathematical Foundations for Electronics and Computer Science	20	20	40	60	2.5	25	--	125

R-2025- S.E (Sem-III) Electronics and Computer Science

Rationale:

The study of Laplace Transform and Inverse Laplace Transform equips students with essential tools to analyze and solve differential equations that model real-world continuous-time systems, such as electrical circuits and control systems, enabling accurate prediction of system behavior in time and frequency domains. The Z Transform extends this analysis to discrete-time signals, which are fundamental in designing and analyzing digital filters and signal processing algorithms in embedded systems. Understanding Graph Theory is crucial for modeling and solving problems related to networks, such as routing in computer networks or optimizing circuit layouts in electronics. The concepts of Functions and Mathematical Relations provide a framework for designing logical circuits, finite state machines, and database schemas, which are integral to both hardware design and software development. Finally, the Fundamental Principle of Counting allows students to approach combinatorial problems common in encryption, data encoding, and hardware configuration, enabling efficient computation and security in computing systems. Together, these topics form a foundation that bridges theoretical mathematics with practical applications in electronics and computer science engineering.

Course Objectives:

1. To understand the fundamentals of Laplace transforms for analyzing continuous-time signals and systems.
2. To explain inverse Laplace techniques to retrieve time-domain signals from the s-domain.
3. To understand Z-transform techniques for the analysis of discrete-time signals in digital systems.
4. To explain key concepts of graph theory for modeling structured data and system interconnections.
5. To describe the role of functions and relations in structuring computational and logical systems.
6. To explain combinatorial techniques to count arrangements and selections relevant to computation and design.

R-2025- S.E (Sem-III) Electronics and Computer Science

Course Outcomes:

1. Students will be able to apply Laplace transforms to model and analyze electrical circuits and control systems in embedded applications.
2. Students will be able to compute the inverse Laplace transform to determine system behavior in electronic filters and feedback systems.
3. Students will be able to Apply Z-transforms to design and analyze digital filters in DSP and signal reconstruction in microcontrollers.
4. Students will be able to use graph algorithms to solve routing, dependency resolution, and circuit layout problems.
5. Students will be able to analyze relations and functions for designing logical circuits, database schemas, and finite state machines.
6. Students will be able to solve counting problems in encryption, data encoding, and digital circuit design using permutations and combinations.

Prerequisite:

1. Basics of integration and its properties.
2. Definition of sets, Venn diagrams, complements, cartesian products, power sets.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e, $sin(at), cos(at), sinh(at), cosh(at)$ and t^n, $n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). Evaluation of integrals by using Laplace	05	CO1

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		Transformation.		
		Self-learning Topics: **1.** Heaviside's Unit Step function. **2.** Laplace Transform. of Periodic functions. **3.** Dirac Delta Function.	07	
II	Inverse Laplace Transform	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. Partial fractions method to find inverse Laplace transform Inverse Laplace transform using Convolution theorem (without proof).	05	CO2
		Self-learning Topics: 1. Applications of Laplace Transforms for solutions to ODE to electrical & electronics circuit problems. 2. Applications to solve initial and boundary value problems involving ordinary differential equations.	07	
III	Z-Transform	Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}$, $\{a^k\}$, $\{c^k \sin(\alpha k+\beta)\}$,$\{c^k sinh\alpha k\}$,$\{c^k \cos(\alpha k+\beta)\}$, $\{c^k cosh\alpha k\}$ Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k. Convolution theorem. Inverse Z transform: Partial Fraction Method	05	CO3
		Self-learning Topics: 1. Initial value theorem.	08	

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		2. Final value theorem. 3. Inverse Using Convolution Theorem. 4. Inverse using Binominal expansion. 5. Inverse using long division.		
IV	Graph Theory	Types of graphs, Graph Representation, Sub graphs. Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components of Graph. Homomorphism and Isomorphism of Graphs. Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex. Trees and application of trees.	05	CO4
		Self-learning Topics: 1. Network Flow Problems – Understanding flow in networks and its optimization. 2. Graph Coloring Applications in Scheduling – Use of graph coloring in timetabling and resource allocation. 3. Optimization Techniques – Application of graphs in shortest path problems, spanning trees, and clustering. 4. Spanning trees.	08	
V	Functions and Mathematical relations	Types: Injective, Surjective, and Bijective Functions. Composition, Inverse Functions. Real life applications of Functions. Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattices, Sub lattice.	05	CO5
		Self-learning Topics: 1. Practical applications of function in Neural Network. 2. Determining risk factors for insurance rates, Taxes and tax brackets, Vending machines, etc.	08	

		3. Practical applications of relations in real life in the field of Database Management, Economics, Social Network, Sports, Medical Diagnosis, Weather, etc. 4. Equivalence Classes.		
VI	Fundamental Principle of Counting	Basic Counting Principle-Sum Rule, Product Rule. Inclusion-Exclusion Principle and Pigeonhole Principle Recurrence relations, Solving recurrence relations	05	CO6
		Self-learning Topics: 1. Applications of Recurrence Relations – Analysis of recursive algorithms in computing. 2. Combinatorial Problem Solving – Using counting techniques in probability and decision-making.	07	

Text Books:

1. 1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.
2. 2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.
3. 3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.
4. 4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.
5. 5. Susanna S. Epp, "Discrete Mathematics with Applications", Cengage Publications, 5th Ed.
6. 6. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Publications.
7. 7. Edgar Goodaire and Michael Parmenter, "Discrete Mathematics and Graph Theory", 3rd Edition, Pearson Publications.

References:

1. Stewart J.: "Multivariable Calculus" Cengage Publications, 7th Ed., 2019.

2. Bali N.P and Goyal M.: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
3. Wylie C. R, Barrett L.C..: "Advanced Engineering Mathematics" McGraw Hill Book Co., New York, 6th Ed., 2017.
4. Ramana B.V.: "Higher Engineering Mathematics", Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
5. Pal S. & Bhunia S. C.: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
6. Kenneth A. Ross, "Discrete Mathematics", 5th Edition, Pearson Publications.
7. Swapan Kumar Sarkar, "Textbook of Discrete Mathematics", 9th Edition, S. Chand Publications.
8. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", 6th Edition, Pearson Education.
9. T. Veera Rajan, "Discrete mathematics with Graph Theory and Combinatorics", McGraw Hill Publications.
10. C. L. Liu "Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/111/106/111106139/
2.	https://www.youtube.com/watch?v=LGxE_yZYigI
3.	https://www.youtube.com/watch?v=lkAvgVUvYvY
4.	https://www.youtube.com/watch?v=sMYtHaSIXbU
5.	https://www.youtube.com/watch?v=XfmbrUBrs5Q
6	https://nptel.ac.in/courses/106106094
7	https://nptel.ac.in/courses/106108227

8.	https://nptel.ac.in/courses/106106183
9.	https://nptel.ac.in/courses/106103205

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical purposes.

2. Students must be encouraged to write **at least 10** class tutorials on the 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. 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. Regularity and active involvement (Theory and Tutorial) 05 marks.

2. Class Tutorials on entire syllabus 10 marks.

3. Mini Project 10 marks.

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Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notiona l Learnin g Hour	Total Credits (C) Notional Learning Hour/30
13211302	Electronic Devices and Circuits	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211302	Electronic Devices and Circuits	20	20	40	60	2.5	--	--	100

R-2025- S.E (Sem-III) Electronics and Computer Science

Rationale: Electronic Devices and Circuits (EDC) syllabus provides a strong foundation in analog electronics, essential for understanding and designing real-world electronic systems. It covers key topics such as diodes, transistors, amplifiers, and power devices, enabling students to analyze and build basic analog circuits. The course bridges theoretical concepts with practical applications in signal processing, power conversion, and control. This prepares students for advanced studies and industry-oriented projects in electronics and communication engineering.

Course Objectives:

1. To enable students to **identify** different configurations of PN junction diode-based clippers and clampers along with their input-output waveforms and transfer characteristics.
2. To enable students to **explain** the working and mathematical analysis of full-wave center-tapped and bridge rectifiers, and to explain the operation and ripple factor of different filter circuits
3. To enable students to **demonstrate** knowledge of biasing, small-signal models, and design procedures for BJT amplifiers.
4. To enable students to **analyz**e and design MOSFET-based circuits, including DC load line, biasing, AC load line, small-signal models, and common-source amplifier configurations.
5. To enable students to **understand** the types, classifications, and working principles of power amplifiers.
6. To enable students to **explain** the construction, characteristics, and applications of power electronic devices.

Course Outcomes:

1. **Demonstrate** Semiconductor applications as clipper and clamper
2. **Analyze** the operation and performance of rectifier and filter circuits
3. **Evaluate** the performance of BJT circuits using DC and AC analysis for various operating conditions.
4. **Apply** DC and AC analysis techniques to design and evaluate MOSFET-based electronic circuits.
5. **Explain** the principles and classifications of power amplifiers, including Class A, B, AB, and C, and describe the operation of power amplifiers using MOSFETs.
6. **Illustrate** the construction, characteristics, and applications of power electronic devices

R-2025- S.E (Sem-III) Electronics and Computer Science

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	BEEE, Semiconductor Physics		
1	Clippers & Clampers	Theoretical description of basic structure & construction of p n junction diode, symbol, operation under zero bias, forward bias & reverse bias, avalanche breakdown, V-I characteristics & temperature effects (no mathematical analysis or numerical examples). Application of P-N junction diode as clippers & clampers (different types of configurations with input-output waveforms & transfer characteristics; theoretical description & analysis of each circuit; numerical examples)	08	CO1
		Self-Learning: P-N junction formation & energy bands Forward vs reverse bias effects Avalanche vs Zener breakdown Clipper/clamp circuits: types, waveforms Diode applications in real-world electronics	08	
2	Rectifiers & Filters	Rectifiers: Working & mathematical analysis of full – wave center tapped rectifier & bridge type rectifier (mathematical analysis include expressions for the DC / average & RMS output voltage, DC / average & RMS output current & ripple factor; numerical examples included)	07	CO2

		Filters: Capacitor (C), Inductor (L), Inductor – Capacitor (LC), C-L-C (π) with circuit diagram, waveforms, working / operation & expression for ripple factor (theoretical description only – no mathematical analysis or numerical examples to be included)		
		Self-Learning: Rectifiers ● Comparison: Half-wave vs full-wave vs bridge ● Efficiency and ripple factor analysis ● Effect of transformer turn ratio on output ● Diode conduction periods and current paths Filters ● Role of capacitors and inductors in smoothing ● Designing filters for specific ripple limits ● Practical applications in power supplies ● Effects of load resistance on filter performance	07	
3	Bipolar Junction Transistor Based Circuits	DC Circuit Analysis: DC load line and region of operation, common bipolar transistor configurations, biasing circuits, bias stability and compensation, analysis and design of biasing circuits. AC Analysis of BJT Amplifiers: AC load line, small signal models (h-parameter model, Hybrid-pi model), graphical analysis, ac equivalent circuits and analysis to obtain voltage	08	CO3

		gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers. Design of CE Amplifier		
		Self-Learning: Select **biasing method** (usually voltage divider). Choose **Rc** and **Re** for gain and stability. Ensure **Q-point** is at the center of the active region. Decide **bypass capacitor** for full AC gain. Calculate **coupling capacitor** values for desired frequency response. Understand **frequency response**, bandwidth.	08	
4	MOSFET Based Circuits	DC Circuit Analysis: DC load line and region of operation, common MOSFETs configurations, analysis and design of biasing circuits AC Analysis: AC load line, small-signal model of MOSFET at high and low frequency and its equivalent circuit, small-signal analysis of MOSFET amplifiers, common-source, source follower, common gate. Design of CS Amplifier using MOSFETS	08	CO4
		Self-Learning: **DC Analysis**: Understand the DC load line, MOSFET operating regions (cutoff, triode, saturation), and biasing (voltage divider preferred). **AC Analysis**: Learn AC load line, small-signal model (low/high frequency), and amplifier	08	

		configurations (common-source, source follower, common gate).		
5	Power Amplifier	Introduction to power amplifiers, difference between voltage and power amplifiers. Classification of Class A, Class-B, Class- AB, Class-C power amplifiers, power amplifier using MOSFET	05	CO5
		Self-Learning: Understand the difference between voltage and power amplifiers in terms of output power and load handling. Study Class A, B, AB, and C amplifier operation, efficiency, and linearity characteristics. Learn how MOSFETs are used in power amplifier circuits, especially in Class AB and high-efficiency designs.	05	
6	Power Electronic Devices	Introduction to power electronic devices and its needs.Introduction, scope and application, construction and characteristics of thyristors, power MOSFET, IGBT, IGCT and GTO. Applications of power electronic devices Case Study 1: "Design of a Low-Cost Analog Power Supply and Signal Conditioner for LED-based Torch Circuit" Case Study 2: "Analog Front-End Design for Soil Moisture Sensor in Smart Agriculture" Case Study 3: "Design of Analog Audio Preamplifier Circuit for Mobile or Bluetooth Speaker"	06	CO6
		Self-Learning:	06	

		Understand the **need for power electronic devices** in efficient control and conversion of electrical power. Study the **construction, characteristics, and switching behavior** of thyristors, power MOSFETs, IGBTs, IGCTs, and GTOs. Explore applications of these devices in **motor drives, power supplies, inverters, converters**, and **renewable energy systems**.		
	Total		90	

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Boylestead," Electronic Devices and Circuit Theory", Pearson Education
3. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press
4. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
5. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage Hughes, Newnes Publisher.

References:

1. Millman and Halkies, "Integrated Electronics", Tata McGraw Hill.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits
3. Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.
4. Muhammad H. Rashid, "Power Electronics - circuits, devices and applications", Prentice Hall of India, 2nd edition.
5. P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.

Online References:

NPTEL courses on microelectronics: Devices to circuits

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
13211303	Computer Organization & architecture	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211303	Computer Organization & architecture	20	20	40	60	2.5	--	--	100

Rationale: Computer Organization and Architecture (COA) provides essential knowledge of how computer systems function at the hardware level. It covers topics like CPU design, memory systems, instruction execution, and input/output mechanisms. For Electronics and Computer Science Engineering students, COA bridges hardware and software, enabling a

deeper understanding of system performance, embedded systems, and low-level programming. This foundation is crucial for advanced studies and careers in system design, hardware development, and software optimization.

Course Objectives:

1. To enable students to **Describe** the basic components of a computer and explain different architecture models and number representations**.**
2. To enable students to **Analyze** instruction formats and control unit designs; compare RISC and CISC architectures.
3. To enable students to **Explain** the memory hierarchy and apply cache and virtual memory techniques in system design.
4. To enable students to **Illustrate** I/O communication methods and differentiate between various interfacing techniques.
5. To enable students to **Understand** parallel computing models and evaluate pipelining performance and hazards.
6. To enable students to **Examine** advanced processor features like GPUs and multicore systems and discuss their real-world applications.

Course Outcomes:

1. **Explain** basic computer architecture and number systems.
2. **Analyze** processor structure and instruction execution.
3. **Apply** memory organization concepts in system design.
4. **Demonstrate** I/O handling and interfacing techniques.
5. **Evaluate** pipeline and parallel processing performance.
6. **Examine** modern processor features like GPUs and multicore systems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Digital Electronics, Data structure, fundamental concept of processing		

1	Introductory Concepts	1.1 Basic Building blocks of a Computer, Moore's law, Evolution of x86 Computers, Von Neumann model, Harvard Model, Performance measures 1.2 Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation 1.3 Booth's Multiplier, Restoring and Non-Restoring Division	07	CO1
		Self-Learning: ● History and Future of Moore's Law ● Comparison: Von Neumann vs Harvard Architectures in Modern CPUs and Microcontrollers ● Floating Point Precision Errors in Scientific Computing ● IEEE 754 Format – Handling Subnormal Numbers and Exceptions ● Binary Multipliers in Hardware Design: Beyond Booth's Algorithm ● Real-World Use of Restoring/Non-Restoring Division in Embedded Systems	07	
2	Processor Organization	2.1 Instruction format, Instruction cycle, Instruction set types, Addressing Modes 2.2 Data path Organization (including Control sequences) 2.3 Control Unit Design: Hardwired and Microprogrammed, Nano-programming 2.4 CISC vs RISC: Design philosophy and issues	09	CO2

		Self-Learning: ● How Instruction Set Design Affects Compiler Optimizations ● RISC-V: Open Source Instruction Set Architecture and Its Growing Popularity ● Evolution of Microprogramming – Why it's Still Relevant in Niche CPUs ● Instruction Pipeline in Modern ARM Processors ● Real-world Example of Addressing Modes in Assembly Programming ● VLIW (Very Long Instruction Word) Architecture – An Alternative Design Approach	09	
3	Memory Organization	3.1 Types of memories, Performance parameters of a Memory system, Memory Hierarchy, Memory Interleaving 3.2 Cache memory concepts: Principles of locality of Reference, Cache mapping techniques, Cache architectures, Cache coherency (Brief Discussion on MESI model) 3.3 Virtual management concepts: Paging, Segmentation, Page Replacement policies 3.4 Case Study: Virtual Memory management in Pentium Processor	09	CO3

		Self-Learning: ● DRAM vs SRAM: Use Cases and Architectural Differences ● Modern Cache Architectures: Inclusive vs Exclusive Caches ● Translation Lookaside Buffer (TLB) – Role in Virtual Memory ● Memory Interleaving Techniques in Multi-Channel RAM ● Advanced Paging Techniques in 64-bit Systems ● Case Study Extension: Comparing Virtual Memory in Linux vs Windows	09	
4	I/O Organization	4.1 I/O interfacing: Handshaking, Interrupt handling, Direct memory Access (DMA) 4.2 I/O Buses: Protocols, Arbitration	05	CO4
		Self-Learning: ● USB vs PCIe: Protocol Comparison and Use in Modern Devices ● Interrupt Handling in Linux Kernel (Advanced Study) ● Role of DMA in High-Speed I/O (e.g., SSDs and GPUs) ● Comparison of Synchronous and Asynchronous I/O Techniques ● NVMe Storage Protocol – Replacing SATA in High-Performance Systems	05	
5	Parallel processing	5.1 Introduction to Parallel processing, Flynn's Classification, Amdahl's Law 5.2 Pipelining, Pipeline Performance metrics, Pipeline Hazards and Solutions	07	CO5
		Self-Learning: ● Flynn's Taxonomy: Where Do GPUs and TPUs Fit In?	07	

		• Instruction Level Parallelism (ILP) in Superscalar Architecture • Pipelining in RISC-V vs x86 CPUs • Real-world Pipeline Hazards and How Modern CPUs Solve Them • Amdahl's Law vs Gustafson's Law in Scaling Multicore Systems		
6	Enhancements of Advanced Processor Architectures	6.1 Superscalar processors, Branch Prediction logic, GPUs, Clusters, Multi-core processors 6.2 NVIDIA GPU Case study and Programming Model Case Study 1: "Intel vs ARM Architectures – A Comparative Study Case Study 2: "Cache Optimization in High-Performance Computing" Case Study 3: "Virtual Memory Management in Linux Systems"	08	CO6
		Self-Learning: • Modern Branch Prediction Algorithms (e.g., TAGE, GShare) • Introduction to CUDA Programming for NVIDIA GPUs • Tensor Cores in NVIDIA GPUs: Role in AI Workloads • ARM Big.LITTLE Architecture in Mobile CPUs • Multicore vs Manycore Architectures (Intel Xeon vs NVIDIA GPUs) • Performance Bottlenecks in Superscalar vs VLIW CPUs	08	
	Total		90	

Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill,2002.
3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9th Edition,

References:

1. P. Hayes, "Computer Architecture and Organization", McGraw-Hill,1998.
2. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", Second Edition, Tata McGraw-Hill.
3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", MorganKaufmann,1998.
4. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
5. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition

Online References:

NPTEL course: https://onlinecourses.nptel.ac.in/noc22_cs88/preview

R-2025- S.E (Sem-III) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
13211304	Data Structures and Algorithms	3	0	-	45			45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211304	Data Structures and Algorithms	20	20	40	60	2.5			100

R-2025- S.E (Sem-III) Electronics and Computer Science

Rationale: Data structures and algorithms are essential for efficiently organizing and processing data, enabling the development of scalable and optimized software solutions.

Course Objectives:

1. **To introduce** fundamental data structures and their applications in problem-solving.
2. **To develop** an understanding of algorithm design techniques like recursion, divide-and-conquer, and greedy methods.
3. **To implement** various data structures such as arrays, linked lists, stacks, queues, trees, heaps, and graphs.
4. **To analyze** the efficiency of algorithms using time and space complexity (Big-O notation).
5. **To apply** appropriate data structures for various real-world computing problems.
6. **To prepare** students for advanced topics in algorithms and competitive programming.

Course Outcomes:

1. Implement various linear data structures.
2. Implement various nonlinear data structures.
3. Select appropriate sorting and searching techniques for a given problem and use it.
4. Develop solutions for real world problems by selecting appropriate data structure and algorithms.
5. Analyze the complexity of the given algorithms.

6. Demonstrate problem-solving skills through implementation of data structure-based solutions in the projects or lab exercises

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Data Structures**	Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of array,Static arrays vs Dynamic Arrays, structures. Introduction to Analysis of Algorithms, characteristics of algorithms, Time and Space complexities, Asymptotic notations.	09	CO1
		Self-learning Topics:Linked Lists application **Case Study:** Implementing a Music Playlist Manager	09	
II	**Stack and Queues**	Introduction,Basic Stack Operations, Representation of a Stack using Array, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation. Queue, Operations on Queue, queue-Round Robin Algorithm	07	CO2
		Self-learning Topics:"Implementing a Circular Queue and its Applications in Real-Time Systems"	07	

		Case Study: "Expression Evaluation and Syntax Parsing in Compilers using Stacks"		
III	**Linked List**	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List (SLL), Operations on Singly Linked List: Insertion, Deletion,reversal of SLL, Print SLL. Circular Queue, concept of priority Queue, Applications of Circular Linked List	07	CO3
		Self-learning Topics: Implementing and Comparing Different Types of Linked Lists (Singly, Doubly, Circular) **Case Study**: "Dynamic Memory Allocation in Operating Systems using Linked Lists"	07	
IV	**Trees and Graphs**	Introduction, Tree Terminologies, Binary Tree, Types of BinaryTree, Representation of Binary Trees, Binary Tree Traversals,Binary Search Tree Operations on Binary Search Tree, GraphTerminologies, Representation of graph (Adjacency matrix and adjacency list), Graph Traversals – Depth First Search (DFS)and Breadth First Search (BFS)	09	CO4
		Self-learning Topics:Understanding and Implementing Binary Search Trees (BST) with Real-Time Insertion and Deletion	**09**	

		Case Study: Hierarchical File System Representation Using Tree		
V	**Sorting and Searching**	Introduction to Searching: Linear search, Binary search, Sorting: Internal VS. External Sorting, Sorting Techniques: Bubble, Insertion, selection, Quick Sort, Merge Sort, Comparison of sorting Techniques based on their complexity. Hashing Techniques, Different Hash functions, Collision & Collision resolution techniques:Linear and Quadratic probing, Double hashing.	07	CO5
		.**Self-learning Topics:** Comparative Study and Implementation of Sorting Algorithms (Bubble, Insertion, Merge, Quick) **Case Study:** Optimizing E-Commerce Product Listings Using Sorting and Searching Algorithms	07	
VI	**Greedy method and Dynamic Programming**	Knapsack Problem, Minimum Cost Spanning Trees, Longest Common Subsequence	06	CO6
		Case Study: Optimizing Relief Material Distribution using the Knapsack Problem	06	
Total			90	

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education

2. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson

3. Data Structures using C, Reema Thareja, Oxford

4. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.

5. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg& Behrouz A. Forouzan, Second Edition, CENGAGE Learning

References:

1. Data Structure Using C, Balagurusamy.

2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India

3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.

4. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.

5. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.

6. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106102064
2.	Coursera link: https://www.coursera.org/specializations/algorithms

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notion al Learning Hour	Total Credits(C) Notional Learning Hour/30
13212305	Electronic Devices and Circuits Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212305	Electronic Devices and Circuits Lab	--	--	--	--	25	25	50

Lab Objectives:

Lab course aims to

1. To provide hands-on experience with basic electronic devices and circuits.
2. To understand the characteristics and operation of diodes, BJTs, and MOSFETs.
3. To analyze and measure key circuit parameters experimentally.
4. To introduce circuit simulation using software tools like SPICE.
5. To design and test amplifiers and biasing circuits.
6. To study the characteristics and applications of power electronic devices.

Lab Outcomes:

After the successful completion students should be able to

1. Analyze the operation of diode-based circuits including clippers, clampers, and rectifiers.
2. Simulate rectifier and filter circuits using SPICE and interpret the output waveforms.
3. Design and evaluate BJT amplifier circuits based on AC and DC analysis.
4. Compare and analyze biasing and amplifier configurations using MOSFETs.
5. Verify amplifier performance using theoretical calculations, simulation, and hardware.
6. Interpret and study the static characteristics of power devices like SCR, TRIAC, and DIAC.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	**BEE Lab, Semiconductor Physics Lab**		
1	**Study of Clipping Circuits** (Series and Shunt Clippers with and without bias – observe input/output on CRO).	2	LO1

2	**Study of Clamping Circuits** (Positive, Negative, and Biased Clampers – analyze waveforms).	2	LO1
3	Study of **Full-Wave Center-Tapped Rectifier**: Observe waveforms, measure Vdc and ripple.	2	LO2
4	Study of **Full-Wave Bridge Rectifier**: Compare with center-tap; observe and measure waveforms.	2	LO2
5	Implementation of **C, L, LC, and π Filters** and observation of their smoothing effect on CRO.	2	LO2
6	Compare different Biasing Circuits of BJT	2	LO3
7	To perform AC, DC, Transient and frequency response of single stage CE amplifiers.	2	LO3
8	Design CE amplifier for a given specification	2	LO3
9	Compare different Biasing Circuits of MOSFETS	2	LO4
10	To perform AC, DC, Transient and frequency response of single stage CS MOSFET amplifiers.	2	LO4
11	**Construction and Testing of Class A Power Amplifier**: Bias a transistor in the active region; plot input/output waveforms and calculate efficiency.	2	LO5
12	**Class B Push-Pull Amplifier**: Build and test a Class B configuration using complementary transistors; observe crossover distortion.	2	LO6
13	Study of static characteristics of SCR	2	LO6
14	Study of static characteristic of Triac and Diac	2	LO6

15	**Triggering Methods of SCR using Gate Signal**: Study various gate triggering techniques (R, RC, UJT-based).	2	LO6

Text Books:

1. David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.
2. Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", 2nd edition, PHI, 1995
3. Mithal. G.K, "Practicals in Basic Electronics", G K Publishers Private Limited, 1997.

Online Resources:

Sr. No.	Website Name
1.	https://www.allaboutcircuits.com/
2.	https://www.tinkercad.com/
3.	https://www.circuitlab.com/

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 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 and practical examination will be held based on the above syllabus.

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)

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
13212306	Data Structures and Algorithms Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212306	Data Structures and Algorithms Lab	--	--	--	--	25	25	50

Lab Objectives:

1. **To provide hands-on experience** in implementing basic and advanced data structures using a programming language (e.g., C/C++, Python, Java).
2. **To enable students** to implement linear data structures such as arrays, stacks, queues, and linked lists.
3. **To develop proficiency** in designing and implementing non-linear data structures like trees, heaps, and graphs.
4. **To enhance understanding** of sorting and searching algorithms through practical coding.
5. **To train students** to evaluate algorithm performance in terms of time and space complexity.
6. **To build confidence** in applying data structures for solving real-world computational problems.

Lab Outcomes:

1. Students will be able to implement linear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.

2. Students will be able to implement nonlinear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.

3. Students will be able to choose appropriate data structure and apply it in various problem domains.

4. Students will be able to select appropriate searching techniques for given problems.

5. Students will be able to Compare and contrast different data structures for solving a given problem effectively.

6. Apply appropriate data structures and algorithms in mini-projects or case studies to solve practical problems.

List of Experiments.

Sr No	List of Experiments	Hrs
01	*Implement Stack ADT using array	2
02	*Convert an Infix expression to Postfix expression using stack ADT	2
03	Evaluate Postfix Expression using Stack ADT	2
04	Check whether parentheses are balanced or not.	2
05	*Implement Linear Queue ADT using array	2
06	Implement Circular Queue ADT using array	2
07	Implement Priority Queue ADT using array	2
08	*Implement Singly Linked List ADT	2
09	Implement Doubly Linked List ADT	2
10	*Implement Stack ADT using Linked List	2
11	*Implement Linear Queue ADT using Linked List	2
12	*Implement Depth First Search and Breadth First Search Graph Traversal technique	2
13	Write a program to Find the Missing Number	2
14	Count 1's in a sorted binary array	2
15	Find the closest pair from two sorted arrays	2

Sr No	List of Assignments / Tutorials	Hrs
01	Practice problems on asymptotic notation (Big O, Theta, Omega).	1

02	Compare complexity of recursive vs. iterative algorithms.	1
03	Solve problems on bubble, insertion, selection, merge, and quick sort.	1
04	Analyze best, average, and worst-case time complexities.	1
05	Solve problems like Tower of Hanoi, binary search, and merge sort using recursion.	1
06	Solve problems On binary search,	1
07	Solve problems On binary merge sort	1
08	Solve problems On binary Quick sort	1

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education

2. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson

3. Data Structures using C, Reema Thareja, Oxford

4. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.

5. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg& Behrouz A. Forouzan, Second Edition, CENGAGE Learning

References:

1. Data Structure Using C, Balagurusamy.

2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India

3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.

4. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.

5. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.

6. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106102064
2.	Coursera link: https://www.coursera.org/specializations/algorithms

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 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 and practical examination will be held based on the above syllabus.

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)

R-2025- S.E (Sem III) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Teaching Scheme (Contact Hours Per Semester)					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
9951137 XX	Open Elective	2	-	-	30	-	-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
9951137 XX	Open Elective	--	--	--	--	--	25	--	25

Students must select a course for Open Elective from a bucket provided by the Rahul Education Group.

Term Work Assessment: 25 Marks (Total marks) = 15 Marks (Case Study/Activity) + 5 Marks (Assignments) + 5 Marks (Attendance)

R-2025- S.E (Sem III) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431308	**Entrepreneurship Development**	**2**	**-**	**-**	**30**		**-**	**30**	60	**2**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98431308	**Entrepreneurship Development**	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is a crucial skill in the 21st century, fostering innovation, self-employment, and economic development. This course is designed to equip students with practical entrepreneurial competencies such as ideation, business model development, financial planning, legal frameworks, and pitching.

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.
3. Develop comprehensive business plans and financial strategies.

4. Explore legal and funding options for startups in India.
5. Apply marketing, digital tools, and CRM for business growth.
6. Design prototypes and present business pitches to stakeholders.

Course Outcomes:

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

1. Explain entrepreneurial concepts and analyze types and traits of entrepreneurs.
2. Apply ideation techniques and validate business ideas using customer discovery tools.
3. Create business plans with financial projections and risk analysis.
4. Evaluate funding sources and legal requirements for a startup.
5. Implement digital marketing and branding strategies effectively.
6. Prepare and deliver compelling business pitches with basic prototyping.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.		
I	**Introduction to Entrepreneurship**	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	4	CO1
		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 **Case Study**: Nirma – A middle-class entrepreneur revolutionizing detergents.	4	
II	**Business**	Ideation Techniques: Design Thinking,	5	CO2

	Idea Generation & Validation	Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.		
		Self-learning Topics: Lean Canvas, Persona Creation **Case Study:** Airbnb – Validating the concept with MVP	5	
III	**Business Planning & Strategy**	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management.	5	CO3
		Self-learning Topics: Financial forecasting using Excel/Google Sheets. **Case Study:** Zomato – Expansion through mergers & strategic pivots	5	
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	6	CO4
		Self-learning Topics: DPIIT recognition process and types of funding **Case Study:Paytm –** From Wallet to IPO: Funding journey	6	
V	**Marketing & Digital Presence**	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models.	5	CO5

		Self-learning Topics: Use of Canva, Google Analytics **Case Study:** Lenskart Omnichannel e-commerce marketing	5	
VI	**Business Pitching & Prototype Development**	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch.	5	CO6
		Self-learning Topics: Canva for pitch deck or Successful Start-ups **Case Study:** Dunzo – MVP to final app evolution	5	
Total			30	

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 References:

Sr. No.	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

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance)

R-2025- S.E (Sem III) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98451309	**Environmental Science**	**2**	**-**	**-**	**30**		**-**	**30**	60	**2**

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98451309	**Environmental Science**	20	20	40	60	2.5	--	--	100

Rationale :

Environmental Science provides a multidisciplinary perspective to understand, analyze, and solve ecological challenges. With growing global concern over climate change, pollution, and sustainable development, it is essential to equip students with the knowledge, skills, and values needed to contribute to sustainable solutions.

Course Objectives:

1. To understand the interrelationship between human activities and the environment.
2. To explore natural ecosystems and biodiversity conservation techniques.
3. To identify causes, effects, and mitigation strategies for various types of environmental pollution.

4. To analyze key environmental policies, laws, and sustainability practices.
5. To develop awareness, ethics, and responsibility towards environmental protection.
6. To promote sustainable development through informed decision-making and community participation.

Course Outcomes:

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

1. Explain core concepts of environmental science and ecological balance.
2. Identify sources and impacts of pollution on ecosystems and human health
3. Evaluate biodiversity importance and conservation strategies.
4. Analyze climate change, global warming, and their mitigation approaches.
5. Interpret government policies and sustainable practices for environment management.
6. Propose solutions for environmental issues at local and global levels.

Prerequisite: Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.		
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	5	CO1

		human health Women and child welfare.		
		Self-learning Topics: Environmental ethics **Case Study**: Chipko Movement (India) – Grassroot conservation.	5	
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 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.	5	CO2
		Self-learning Topics: Carbon footprint calculators **Case Study:** Rainwater Harvesting	5	
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,	5	CO3

		Oceans, estuaries). Case study on various ecosystems in India.		
		Self-learning Topics: Biodiversity in Indian context **Case Study:** various ecosystems in India.	5	
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.	5	CO4
		Self-learning Topics: Indoor pollution sources	5	
V	**Environmental Pollution Definition**	Causes of Pollution , 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.	5	CO5
		Self-learning Topics: Greenhouse gases **Case study:** Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	5	

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 solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Consumerism and waste products. Environment protection act. Public awareness.	5	CO6
		Self-learning Topics: Environmental audit methods. **Case Study:** Environmental Ethics.	5	
Total			30	

Text Books:

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 1. 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

References:

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, Earth 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)

R-2025- S.E (Sem-III) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
13612310	IDEA LAB - III (Innovation Design Engineerin g and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13612310	IDEA LAB - III (Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

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c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

1. **Motivating and Inspiring Students**
   - Encourage students to take ownership of their learning and projects.
   - Cultivate a mindset of curiosity, exploration, and social relevance.
   - Foster an environment where students feel empowered to take creative risks.
2. **Conducting Brainstorming and Ideation Sessions**
   - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
   - Promote collaborative thinking, design exploration, and interdisciplinary integration.
3. **Arranging Guest Lectures and Expert Talks**
   - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
   - Facilitate exposure to real-world challenges, current trends, and future opportunities.
4. **Ensuring Uniqueness and Originality of Projects**
   - Actively review proposed ideas to ensure **no duplication of solutions** across students.
   - Encourage students to explore novel approaches, technologies, and perspectives.
5. **Promoting Discussion and Collaborative Learning**
   - Create platforms for students to present, discuss, and receive peer and mentor feedback.

- Facilitate idea refinement through regular discussions and group engagement.

6. **Aligning Subject Content Beyond Syllabus**
   - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
   - This ensures relevance, depth, and meaningful interdisciplinary integration.
7. **Same Semester Faculty Requirement**
   - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
8. **Monitoring and Documentation**
   - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
   - Provide ongoing feedback and ensure project alignment with learning outcomes.
9. **Coordination with Subject Faculty**
   - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
   - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	**Faculty in-charges assigned based on project nature and department capacity.**
Mentoring Role	**Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.**
Capacity Building	**Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.**
Assessment Contribution	**Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.**

Aspect	Implementation Strategy
Recognition & Incentives	**Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.**

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b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	**Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.**
Independent Evaluation	**Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a** separate 25 marks allocated for termwork based on subject **application.**
Evidence Sources	**Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.**
Outcome Assurance	**Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.**

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
  - Logbooks
  - Subject-specific outputs (e.g., simulations, designs)
  - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

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b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	**Marks**	**Description**
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

Shree Rahul Education Society's (Regd.)

Shree L.R. Tiwari College of Engineering

Shree L.R. Tiwari Educational Campus, Mira

Road–East, Thane-401 107.Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Electronics and Computer Science

A.Y 2025-26

Second Year: Semester IV

Prepared by: Board of Studies for Electronics and Computer Science

Approved By: Academic Council of Shree L.R. Tiwari College of Engineering

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class centre for socio- economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mind-set essential for success in today's evolving professional landscape.

1. **Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented the autonomous curriculum adopts a bottom-up, learner-concentric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socioeconomic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem- solving.**
2. **Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the IDEA Lab—our dedicated innovation and problem-solving hub— students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impact solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.**
3. **Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.**
4. **Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.**
5. **Empowering Faculty as Mentors and Innovators SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.**

Sincerely,

IQAC Chairperson
SLRTCE

COO
Rahul Education

PREFACE FROM CHAIRPERSON (BOS)

Dear Colleagues and Esteemed Members of the Board,

It is my pleasure to present the newly revised Electronics and Computer Science curriculum— crafted under our recently granted Autonomous status and in compliance with NEP 2020 Building upon the strong foundational framework of SLRTCE's legacy—where industry- oriented, tools-based learning complements core computing principles—this syllabus ushers in a truly student-centric, flexible, and future-ready program.

The Electronics and Computer Science (ECS) program at our autonomous institute under Mumbai University is a forward-looking, interdisciplinary course that combines the robust foundations of electronics with the transformative capabilities of computer science. The program equips students with the knowledge and skills needed to design, develop, and optimize intelligent systems, enabling innovation at the intersection of hardware and software.

As an autonomous institution, we utilize academic independence to continuously update and enrich the curriculum to reflect emerging technologies and industry demands, including areas such as Internet of Things (IoT), artificial intelligence, embedded systems, robotics, and cyber- physical systems.

A key feature of the program is the integration of the Idea Lab, a dynamic innovation ecosystem where students engage in hands-on, project-based learning. This lab nurtures creativity, design thinking, and entrepreneurial mindsets, enabling students to take ideas from concept to prototype, often in collaboration with industry, faculty, and the community.

The ECSE program strongly emphasizes societal impact. Students are encouraged to develop technology-driven solutions to address real-world challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs). Whether it is promoting quality education (SDG 4) through ed-tech innovations, enhancing good health and well-being (SDG 3) with biomedical devices, contributing to sustainable cities and communities (SDG 11) through smart systems, or driving climate action (SDG 13) using intelligent environmental monitoring, the curriculum instills a deep sense of purpose and responsibility.

Through a balance of theoretical grounding, practical application, ethical awareness, and social commitment, the ECSE program prepares graduates to become technological leaders, responsible citizens, and agents of sustainable development in a rapidly evolving global landscape.

Mrs. Samita Bhandari
Chairperson, Board of Studies (ECS), SLRTCE

Contents

A. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co-Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

B. Academic Brief

1. **Internal Assessment (Formative Assessment):**
   These assessments aim to evaluate students' continuous academic progress. Internal Assessment (IA) will consists of two compulsory Internal Assessment Test of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour. Summation of the two tests will be considered as IA marks. The first IA will be scheduled around the 6th week, and the second IA around the 13th week from the commencement of the semester.
2. **End Semester Examination (60-Marks):**
   i. Question paper will comprise of total 06 questions, each carrying 10 marks
   ii. The questions for 10M will be based on each module of the syllabus.
   iii. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
   iv. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B. Remaining questions will be in similar nature and selected from the respective module.
   v. Total 06 questions need to be attempted.
3. **IDEA Lab Formative Assessment:**
   Monthly formative assessments will be conducted for IDEA Lab activities to monitor creativity, innovation, and problem-solving skill development.
4. **Monthly Defaulter List:**
   A defaulter list identifying students with attendance or academic performance concerns will be prepared and circulated every month.
5. **Defaulter Meeting with Attendance Committee:**
   Students listed as defaulters will meet with the Attendance Committee on the first Saturday of every month.

C. Academic Overview-Semester-IV Theme

Theme: “Innovating urban spaces for people and the planet”

- **SDG 11: Sustainable Cities and Communities**
- **SDG 9: Industry, Innovation and Infrastructure**
- **SDG 13: Climate Action**
- **SDG 6: Clean Water and Sanitation**
- **SDG 3: Good Health and Well-being**
- **SDG 12: Responsible Consumption and Production**

Keywords: water quality, waste management, lifestyle diseases, air quality index, entrepreneurship.

Description: The theme **“Innovating Urban Spaces for People and the Planet”** envisions a transformation of city systems to better serve human needs while ensuring environmental sustainability. In rapidly growing urban regions like Mira-Bhayander , rising challenges such as population pressure, pollution, waste management, water quality issues, public health risks, and vulnerability to natural or man-made disasters,demand smart, integrated, and sustainable solutions. This theme highlights the role of digital innovation, including real-time monitoring and data-driven environmental tracking, in building cleaner, healthier, and more resilient cities. It also promotes inclusive urban development by empowering local entrepreneurs, artisans, and communities through technology platforms and networking tools.

By tackling critical issues such as clean water access, air quality, waste reduction, public health, disaster preparedness, and economic inclusion, this approach seeks to create urban spaces that enhance quality of life while protecting natural ecosystems. Ultimately, it supports global sustainability goals by fostering a balance between technological advancement, environmental stewardship, and social equity

C. Academic Overview-Semester-IV Problem Statement

Problem Statements:

1. In metropolitan areas, the quality of water supplied by municipal corporations is often inconsistent and, at times, unsafe. This irregularity in water treatment and distribution can result in contamination, posing significant health risks to the population. Poorly treated or contaminated water can lead to a surge in waterborne diseases such as cholera, typhoid, and gastrointestinal infections. Given the gravity of these risks, there is a pressing need for effective monitoring systems and real-time alert mechanisms to ensure the consistent delivery of safe and clean drinking water to all residents**(UNSD GOAL 6: Clean Water and Sanitation)**
2. Urban areas generate thousands of tonnes of waste daily, including solid, medical, plastic, metal, and electronic waste. The lack of proper disposal and effective segregation leads to severe environmental pollution and public health hazards. To ensure a cleaner, greener, and more sustainable urban future, there is a pressing need for intelligent waste management systems that emphasize reduction, reuse, and recycling**. (UNSD GOAL 12: Responsible Consumption and Production)**
3. Lifestyle-related diseases such as diabetes, hypertension, and heart conditions are increasingly affecting large segments of the population. A significant number of individuals remain unaware of early warning signs, leading to delayed diagnosis and treatment. This often results in the progression of disease and the onset of serious complications. Promoting awareness and ensuring accessible health information and monitoring tools are critical steps toward early detection, timely intervention, and improved long-term care. To address this growing concern, digital health platforms, mobile apps, and wearable devices can be used to monitor vital signs, track symptoms, and provide personalized health alerts**.(UNSD GOAL 3: Good Health and Well-being**)
4. Air pollution is a persistent challenge in metropolitan cities, significantly impacting the health and well-being of millions. The Air Quality Index (AQI) is a vital tool for tracking pollution levels and informing the public, yet gaps in timely data collection and communication hinder its effectiveness. To mitigate pollution-related risks, there is a clear need for advanced real-time monitoring systems and targeted community awareness initiatives. Deploying smart sensors for continuous air quality monitoring, integrating data into public alert systems, and promoting eco-friendly practices through education campaigns can help improve air quality and safeguard public health. **(UNSD GOAL 13: Climate Action)**
5. In densely populated cities there is fear of manmade/natural disaster hence there is need for efficient alert system for people by which human lives can be saved. Create a multi-platform emergency alert system using mobile apps, SMS, and public display boards powered by real-time data (earthquake, flood, fire sensors) for city disaster preparedness. Strengthen resilience of urban areas to natural and man-made disasters. (**UNSD GOAL 13: Climate Action, UNSD GOAL 11: Sustainable Cities and Communities**)
6. Many small entrepreneurs and artisans in local communities struggle to reach wider markets due to limited resources and networking opportunities. Identifying and supporting these individuals through a dedicated platform can help showcase their products and skills. By connecting them with customers, suppliers, and collaborators, such a platform can boost their business growth and promote sustainable local economies. Empowering these entrepreneurs contributes to inclusive development and strengthens community resilience. (**UNSD GOAL 9: Industry, Innovation and Infrastructure**)

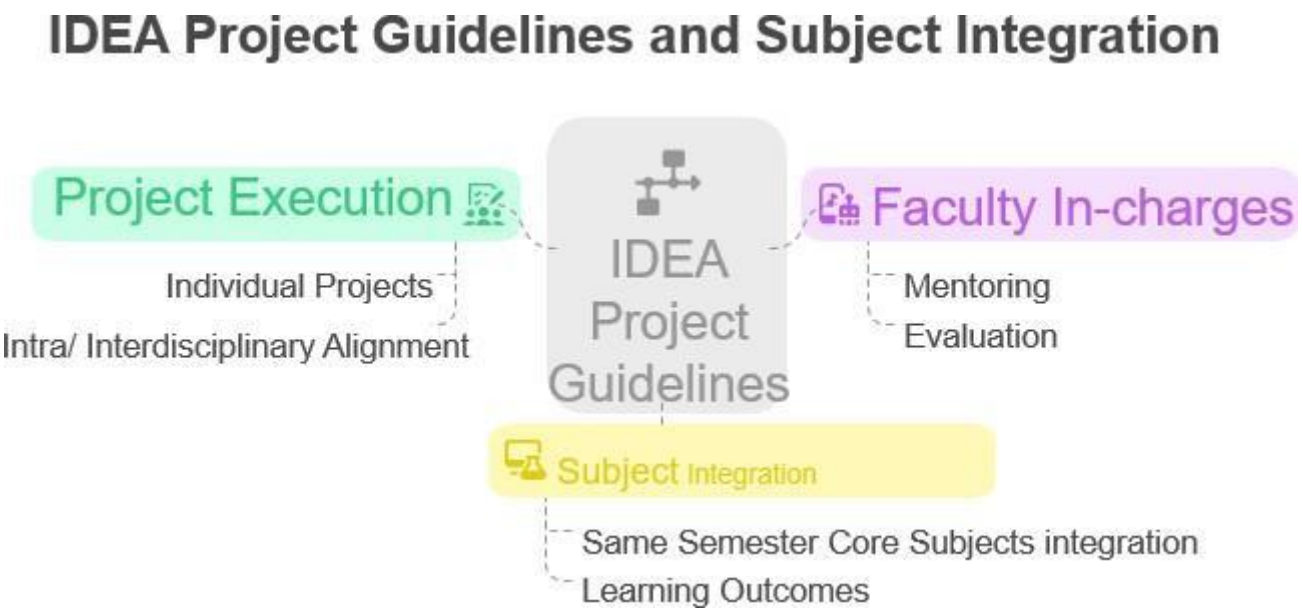
D. Innovation Design Engineering and Apply (IDEA) Lab

1: IDEA Lab: Objectives and Outcomes

The lab bridges the gap between **classroom knowledge and applied innovation**. It nurtures a maker mindset by aligning outcomes with **higher-order thinking**, prototyping, and reflective learning—key goals of NEP-aligned education.

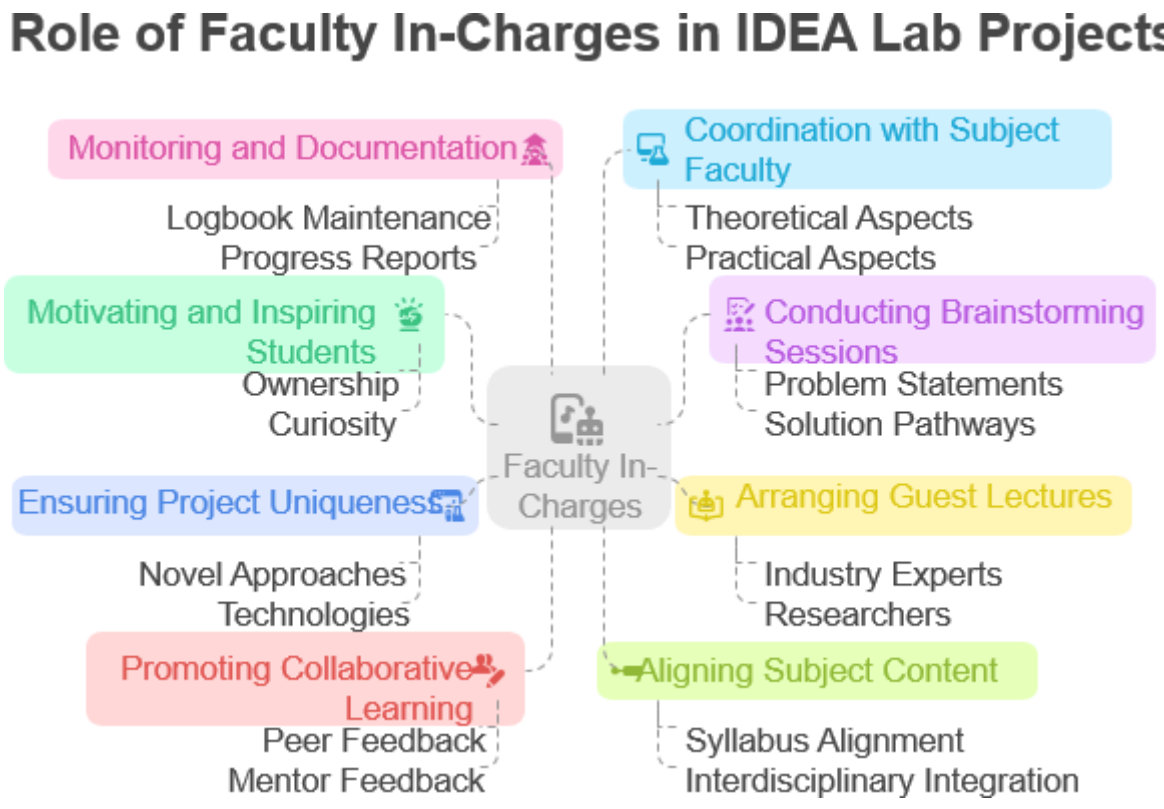
2. IDEA Project Guidelines Comparison

This comparison clarifies the **ecosystem of roles**: students apply interdisciplinary learning; faculty act as academic and innovation guides. Coordination across roles ensures **synergy between syllabus, project outcomes, and real-world relevance**.



3. Faculty In-Charge Implementation Strategies

Faculty implementation is based on a **dual contribution model**: they ensure academic integration through subject mapping and promote innovation via mentoring. The strategy institutionalizes **capacity building, accountability, and interdisciplinary facilitation**.



4. IDEA Lab Project Assessment Criteria

This rubric supports **progressive skill development** across three months—encouraging early ideation, mid-stage feasibility, and final innovation. It integrates **experiential learning and continuous assessment**, fostering critical thinking and ownership, as envisioned in NEP 2020.Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project

Assessment of IDEA Lab Projects (Individual Intra/Interdisciplinary Projects) (25 Marks)

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software /simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

E: Curriculum Structure – SE Semester-IV

Course code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
13211401	PCC	Sampling Theory and Optimization	2	1	-	30	15	-	45	90	3
13211402	PCC	Analog Electronics	3	-	-	45	-	-	45	90	3
13211403	PCC	Discrete Structure and Automata Theory	3	-	-	45	-	-	45	90	3
13212404	PCCL	Analog Electronics lab	-	-	2	-	-	30	-	30	1
13212405	PCCL	IDEA LAB - IV(Innovation Design Engineering and Apply	1	-	2*	15	-	30	15	60	2
13412406	VSEC	Skill lab Java	-	-	2	-	-	30	-	30	1
993114701WW	MDM	To be selected from MDM bucket	3	-	-	45		-	45	90	3
9931248WW	MDML	To be selected from MDM bucket	-	-	2	-	-	30	-	30	1

9951149WW	OE	To be selected from the bucket Rahul Education	2	-	-	30	-	-	30	60	2

98451410	VEC	Design Thinking	2	-	-	30	-	-	30	60	2
98431411	Entrepreneurship	Business Model Development	2	-	-	30	-	-	30	60	2
98471412		Audit Course	3	-	-	45	-	-	-	-	-
		Total	**21**	**1**	**8**	**315**	**15**	**120**	**285**	**690**	**23**

Note:

1) Entrepreneurship and VEC will be common to all Branch

2) BSC, ESC, PCC and corresponding lab is Department Specific

3) Questions based on self-learning must not be asked in internal assessment and End Semester Exam

4) *** IDEA Lab :**The IDEA Lab fosters individual interdisciplinary projects through theme- based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SE Semester-IV

Course code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment			End Sem Exam	Exam Duration for Theory (in Hrs)	Term Work	Pract. & Oral	
			IAT-1	IAT-2	Total					
13211401	PCC	Sampling Theory and Optimization	20	20	40	60	2.5	25	–	125
13211402	PCC	Analog Electronics	20	20	40	60	2.5	–	–	100
13211403	PCC	Discrete Structure and Automata Theory	20	20	40	60	2.5	–	–	100
13212404	PCCL	Analog Electronics lab	–	–	–	–	–	25	25	50
13212405	PCCL	IDEA LAB - IV(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
13412406	VSEC	Skill lab Java	–	–	–	–	–	25	25	50
9931147WW	MDM	To be selected from MDM bucket	20	20	40	60	2.5	–	–	100
9931248W W	MDML	To be selected from MDM bucket	–	–	–	–	–	25	25	50
9951149WW	OE	OE	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business Model Development	–	--	–	–	--	25	–	25

Total	**100**	**100**	**200**	**300**	**12.5**	**200**	**125**	**825**

G. Course Content – Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
13211401	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211401	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In the field of Electronics and Computer Science Engineering, understanding and applying statistical and optimization techniques is essential for designing efficient and reliable systems. Large and small sample tests enable students to analyze data correctly depending on the sample size, such as testing the performance of hardware components or network delays. The Chi-square and F-tests are vital for assessing relationships in categorical data and comparing variances, which are commonly encountered in quality control and hardware testing. Optimization methods like the Simplex Method and Duality help solve real-world resource allocation problems, such

as optimizing computing

resources or bandwidth under various constraints. For more complex scenarios involving nonlinear constraints, the Kuhn-Tucker conditions provide necessary criteria for optimal solutions, often seen in power-efficient circuit design. Markov Chains offer a powerful framework for modeling stochastic systems like network traffic or error correction processes, where future states depend only on the current condition. Finally, Queuing Theory aids in analyzing and improving systems involving waiting lines, such as task scheduling in processors or packet management in routers, ensuring smooth and efficient operations. Together, these topics build a strong foundation for engineering students to tackle practical challenges in their field.

Course Objectives:

1. To explain hypothesis testing techniques for analyzing large and small data samples in electronic and computing systems.
2. To understand the application of Chi-square and F-tests for independence and variance comparison in system data.
3. To describe linear optimization methods to allocate computing resources efficiently.
4. To explain nonlinear constrained optimization techniques applicable to electronic circuit design and software optimization.
5. To understand markov chains for modeling stochastic processes in communication and computer systems.
6. To describe queuing models to analyze delays and throughput in computer networks and electronic systems.

Course Outcomes:

1. Students will be able to evaluate system performance or signal characteristics using Z-tests and t-tests.
2. Students will be able to analyze categorical data or variance in hardware or software performance using Chi-square and F-tests.
3. Students will be able to solve linear programming problems for optimizing resource allocation using simplex method and duality concepts.
4. Students will be able to apply Kuhn-Tucker conditions to solve constrained nonlinear optimization problems in engineering design.
5. Students will be able to analyze state transitions in systems such as error correction or network protocols using Markov chain models.

6. Students will be able to evaluate system performance parameters like waiting time and queue length using queuing theory.

Prerequisite:

1. **Basic Probability Theory, Matrix Algebra.**

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Sampling theory-I	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two tailed test, Degree of freedom. Test significance for large samples. Test the significance of mean. Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)	05	CO1
		Self-learning Topics: 1. Estimate parameters of a population. 2. Test of significance of large samples, Proportion test. 3. Difference between the means of two large samples.	08	
II	Sampling theory-II	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction. Analysis of variance: F-test (significant difference between variances of two samples).	05	CO2
		Self-learning Topics: 1. ANOVA**:** One way classification, 2.ANOVA**:** Two-way classification (short-cut method).	08	

III	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables. Simplex method. Duality, Dual of LPP. Dual Simplex Method.	05	CO3
		Self-learning Topics: 1. Artificial variable method, Big M method. 2. Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	08	
IV	Nonlinear Programming Problems	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions.	05	CO4
		Self-learning Topics: 1. NLPP with one equality constraint (three variables) using the method of Lagrange's multipliers 2. NLPP with one inequality constraint (three variables): Kuhn-Tucker conditions	07	
V	Markov Chains	Introduction to Markov Chains Transition Probability matrix, Transition Diagram Homogeneous Markov Chains Chapman-Kolmogorov Equations for discrete Markov chains.	05	CO5
		Self-learning Topics: 1. Initial Conditions 2. Classification of states	07	

		3. Semi-Markov Chains 4. Markov Processes State Space and Continuous time.		
VI	Queuing Theory	Introduction to Queuing Systems Birth-Death Processes & M/M/1 Queues M/M/c and Finite Queue Models M/G/1 and G/G/1 Queues Queuing Networks		CO6
		Self-learning Topics: 1. Priority Queues. 2. Queueing Disciplines. 3. Retrial Queues & Balking/Reneging 4. Queuing with Server Vacations	07	

Text Books:

1. Operations Research, Hira and Gupta, S. Chand Publication.

2. Fundamentals of Statistics, S. C. Gupta.

3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.

4. Murray Spiegel, "Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.

2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.

3. Operations Research: An Introduction, Hamdy A Taha, Pearson.

4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.

5. S. D. Sharma, "Operations Research", Kedarnath Ramnath Publishing, Meerut, 8th Edition, 2015.

Online References:Assessment:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/117/103/117103017/
2.	https://archive.nptel.ac.in/courses/111/102/111102111/

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical purposes.

2. Students must be encouraged to write **at least 10** class tutorials on the 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 a mini project. 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. Regularity and active involvement (Theory and Tutorial) 05 marks.

2. Class Tutorials on entire syllabus 10 marks.

3. Mini Project 10 marks.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
13211402	Analog Electronics	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
13211402	Analog Electronics	20	20	40	60	2.5	--	--	100

Rationale: Analog Electronics is a fundamental subject that equips students with the essential principles required to analyze, design, and implement electronic circuits used in real-world applications. The course covers key topics such as amplifier configurations, frequency response, feedback systems, oscillators, and waveform generators using BJTs, MOSFETs, and operational amplifiers. It bridges theoretical concepts with practical

circuit behavior, laying a strong foundation for advanced studies in embedded systems, VLSI, instrumentation, and communication systems.

Course Objectives:

1. To enable students **to explain** the frequency response of MOSFET amplifiers and analyze the effect of various capacitances on amplifier performance.
2. To enable students **to illustrate** the working of differential amplifiers and operational amplifiers, including their DC and AC behavior.
3. To enable students to understand the internal architecture, characteristics, and practical parameters of operational amplifiers.
4. To enable students to describe the role of feedback in amplifiers and differentiate between open-loop and closed-loop configurations.
5. To enable students to to analyze and design sinusoidal oscillators and waveform generators using op-amps.
6. To enable students **to apply** op-amp-based circuits in linear and non-linear applications such as adders, integrators, comparators, and timers.

Course Outcomes:

1. **Analyze** the frequency response of MOSFET amplifiers considering the effect of capacitances
2. **Evaluate** MOSFET differential amplifiers under DC and AC conditions and determine CMRR.
3. **Explain** op-amp configurations and the impact of feedback on gain and stability.
4. **Design and Analyze** RC-based oscillator circuits and describe the working of waveform generators.
5. **Implemen**t linear op-amp circuits like adders, integrators, and amplifiers.
6. **Interpret** nonlinear op-amp circuits like comparators, Schmitt triggers, and 555 timer

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Electronic Devices and Circuits		
1	Frequency Response of MOSFET Amplifiers	Low frequency response & analysis, effect of the coupling, bypass & load capacitances on single stage MOSFET amplifier for common source (CS) configuration. High frequency response & analysis, effect of parasitic capacitances on MOSFET amplifiers, high frequency equivalent circuit of MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth (mathematical analysis & numerical examples included). Introduction to multi-stage amplifiers – need & necessity, different types of couplings (DC, R-C & transformer) with advantages & disadvantages, the MOSFET Cascode amplifier (theoretical description only	08	CO1
		Self Learning: **Simulate and analyze** MOSFET amplifiers to study the effects of capacitors and frequency response. **Practice numerical problems** and apply theoretical concepts like Miller's theorem and bandwidth calculation. **Explore multi-stage amplifiers** by comparing different coupling methods and understanding cascode configuration through circuit analysis.	08	

2	Differential Amplifier	Basic MOSFET differential amplifier, DC characteristics, transfer characteristics, small signal(AC) analysis of only dual input balanced output (DIBO) for differential mode gain & common mode gains, Common mode rejection ratio (CMRR) & input resistance / impedance. MOSFET differential amplifier with an active load (theoretical description & only mathematical analysis (no numerical examples).	07	CO2
		Self Learning: Analyze and simulate a MOSFET differential amplifier (DIBO) to understand DC, AC behavior, differential gain, common-mode gain, CMRR, and input impedance. Study and derive theoretical expressions for a differential amplifier with active load.	07	

3	Op-amp	The ideal operational amplifier (op-amp), internal block diagram of op-amp, characteristics of op-amp, ideal & practical op-amp parameters / specifications (no detailed description or any analysis), mathematical model of op-amp, IC 741 op-amp with pin diagram & description Open loop & closed loop configurations (theoretical description only), the concept of virtual ground & virtual short.Basic concepts of feedback,	08	CO3
		Self Learning: **Understand and compare** open-loop vs. closed-loop op-amp configurations and the concepts of virtual ground and virtual short through diagrams and simulations. **Study feedback types**, draw block diagrams, and derive gain formulas for positive and negative feedback. **Explore negative feedback configurations** (voltage/current series/shunt) with theoretical analysis and gain derivations. **Analyze and design** inverting and non-inverting op-amp circuits using mathematical derivations and simulations.	08	

4	Applications of Operational Amplifier	Types of negative feedback – voltage series, voltage shunt, current series & current shunt (theoretical description only), the op-amp inverting amplifier & op-amp noninverting amplifier (mathematical analysis for derivation of output voltage only, numerical examples & designing) Adder, summing amplifier, averaging circuit, subtractor, integrator (ideal), differentiator (ideal), difference amplifier, current amplifier & 3 op-amp instrumentation amplifier (only mathematical analysis for derivation of output voltage with numerical examples & designing included) Current to voltage converters (I to V) & voltage to current converters (V to I) – floating load & grounded load (mathematical analysis only – no numericals)	08	CO4
		Self Learning: Ideal vs Practical Op-Amp Frequency Response of Op-Amp		

5	Oscillators &Comparators	Oscillators: RC phase shift oscillator, Wien bridge oscillator & the crystal oscillator (theoretical description only – no mathematical analysis), numerical example & design problem on RC phase shift oscillator & Wien bridge oscillator Comparators: Inverting comparator, non-inverting comparator, zero crossing detector (ZCD) & Schmitt Trigger (numerical examples & designing problem on the inverting Schmitt Trigger for both symmetrical & non-symmetrical configurations), window detector / comparator (theoretical description only)	05	CO5

		Self Learning: **Study and derive** output voltage formulas for adder, subtractor, integrator, differentiator, averaging, difference, and current amplifier circuits with numerical examples and design tasks. **Analyze** the 3-op-amp instrumentation amplifier with full mathematical derivation. **Understand and derive** expressions for current-to-voltage and voltage-to-current converters for both floating and grounded loads (theoretical only)..	05	
6	Non-Linear Integrated Circuits	IC 555 Timer: pin configuration and block diagram, Operation in astable and monostable multivibrator with mathematical analysis & numerical examples, applications in astable and monostable configurations. **Case Study:** Design of a Smart Temperature Monitoring Circuit Using Analog Components	06	CO6
		Self Learning: **Study and derive** output voltage formulas for adder, subtractor, integrator, differentiator, averaging, difference, and current amplifier circuits with numerical examples and design tasks.	06	

		Analyze the 3-op-amp instrumentation amplifier with full mathematical derivation. **Understand and derive** expressions for current-to-voltage and voltage-to-current converters for both floating and grounded loads (theoretical only).		
	Total		90	

Text Books:

1. Donald A. Neamen, “Electronic Circuit Analysis and Design”, TATA McGraw Hill, 2nd Edition
2. Boylestead," Electronic Devices and Circuit Theory", Pearson Education
3. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press
4. David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.
5. Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage Hughes, Newnes Publisher.

References:

1. Millman and Halkies, “Integrated Electronics”, Tata McGraw Hill.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, “Microelectronic Circuits
3. Theory and Applications”, International Version, OXFORD International Students Edition, Fifth Edition.
4. Muhammad H. Rashid, “Power Electronics - circuits, devices and applications”, Prentice Hall of India, 2nd edition.
5. P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.

Online References:

NPTEL courses on microelectronics: Devices to circuits

R-2025- S.E (Sem- IV) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30
13211403	Discrete Structures and Automata Theory	3	–	--	45	–	--	45	90	3

Course Code		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211403	Discrete Structures and Automata Theory	20	20	40	60	2.5	--	--	100

Rationale :

Discrete Structures and Automata Theory are fundamental subjects in computer science that provide the mathematical and theoretical foundation for understanding computation and algorithms. Discrete structures, like sets, relations, and logic, form the basis for representing data and building algorithms, while automata theory studies abstract models of computation that are essential for designing and analyzing compilers, programming languages, and other computational systems.

Course Objectives:

1. To cultivate clear thinking for Creative Problem Solving.
2. To train students to understand and construct Mathematical Proofs.
3. To introduce the notions of Sets, Relations, Functions, Graphs and their applications.
4. To build concepts of theoretical design of Basic machines, Deterministic and Non Deterministic Finite state machines and Pushdown Machines.
5. To gain the conceptual understanding of fundamentals of Grammars.
6. To prepare students with the mathematical aspects in other courses such as Formal Specification, Verification, Artificial Intelligence etc.

Course Outcomes:

1. Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. To Reason Logically.
3. Perform operations with Sets, Relations, Functions, Graphs and their applications.
4. Design Deterministic Finite Automata (DFA) and Non-deterministic Finite Automata (NFA) and Pushdown Automata with understanding of power and limitations.
5. Design Context Free Grammar and perform the operations like simplification and normal forms.
6. Apply Discrete Structures and Automata Theory concepts into solving real world computing problems in the domain of Formal Specification, Verification, Artificial Intelligence etc.

Prerequisite: Basics of graphs, including their representation, properties, and common algorithms,Algebraic Structures,Logic and Proofs

DETAILED SYLLABUS:

R-2025- S.E (Sem- IV) Electronics and Computer Science

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Basics of graphs, including their representation, properties, and common algorithms,Algebraic Structures,Logic and Proofs**		
I	**Set Theory and Logic**	Set Theory: Fundamentals - Sets and Subsets, Venn Diagrams, Operations on sets, Laws of Set Theory, Power Set,Principle of Inclusion and Exclusion, Mathematical Induction. Propositions and Logical operations, Truth tables, Equivalence, Implications Laws of Logic, Normal Forms, Inference Predicates and Quantifiers	7	CO1
		Self-learning Topics: Venn Diagrams,Set Theory	7	
II	**Relations and Functions**	Relations- Definition, Properties of Relations Types of binary relations (Equivalence and partial ordered relations),Closures, Poset, Hasse diagram and Lattice Functions-Definition, Types of Functions (Injective, Surjective and Bijective) Identity and Inverse Functions Pigeonhole Principle, Extended Pigeonhole Principle	8	CO2
		Self-learning Topics: Discrete Probability	8	
III	**Graph Theory**	Graphs and their basic properties - degree, path, cycle, subgraphs, Types of graphs. Definitions, Paths and circuits: Eulerian and	7	CO3

		Hamiltonian, Planner Graph, Dijkstra Shortest Path Algorithm Trees, Types of Trees		
		Self-learning Topics: Isomorphism of graphs,Shortest Path Algorithms	7	
IV	**Finite Automata**	Introduction of Automata and its applications Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, NFA to DFA Conversion. Eliminating epsilon-transitions from NFA. FSM with output: Moore and Mealy machines.	7	CO4
		Self-learning Topics: Automata and its applications	7	
V	**Regular Expression (RE) and Regular Grammar (RG)**	Regular Grammar and Regular Expression (RE): Definition, Equivalence and Conversion from RE to RG and RG to RE. Equivalence of RE and FA, Converting RE to FA and FA to RE.	8	CO5
		Self-learning Topics: Regular Expression	8	
VI	**Context Free Grammar (CFG) and Push Down Automata (PDA)**	Grammars: Chomsky hierarchy, CFG- Definition, Sentential forms, Leftmost and Rightmost derivations. Context Free languages (CFL): Parsing and Ambiguity. CFLs: Simplification and Applications. Normal Forms: Chomsky Normal Form,PDA-	8	CO6

		Definition, Transitions (Diagrams, Functions and Tables), Design of PDA with Graphical Notation and Instantaneous Descriptions.		
		Self-learning Topics: Applications of PDA	8	
	Total		90	

Text Books:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.
2. C.L.Liu, "Elements of Discrete Mathematics", Second edition 1985, McGraw-Hill Book Company, Reprinted 2000.
3. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation‖", Pearson Education.
4. Vivek Kulkarni, "Theory of Computation", Oxford University Press, India.

References:

1. K.H.Rosen, "Discrete Mathematics and applications", fifth edition 2003, Tata McGraw Hill publishing Company.
2. Y N Singh, "Discrete Mathematical Structures", Wiley-India.
3. J .L.Mott, A.Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.
4. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Tata Mcgraw-Hill.
5. Seymour Lipschutz, Marc Lars Lipson," Discrete Mathematics" Schaum's Outline, McGraw Hill Education.
6. Daniel I. A. Cohen," Introduction to Computer Theory", Wiley Publication.

Michael Sipser, "Theory of Computation", Cengage learning.

7. J. C. Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs49/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105192/
3.	https://archive.nptel.ac.in/courses/106/103/106103070/

R-2025- S.E (Sem- IV) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) Notional Learning Hour/30
13212404	Analog Electronics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	Total				
13212404	Analog Electronics Lab	--	--	--	--	25		50

Lab Objectives:

Lab course aims to

1. To design and analyze the frequency response of single-stage and Cascode MOSFET amplifiers, and evaluate their performance across low and high frequencies.
2. To determine the input and output impedance of a common source (CS) amplifier, both with and without feedback, and study its impact on amplifier behavior.
3. To study various configurations of operational amplifiers (inverting, non-inverting, differential, and instrumentation amplifiers) and measure their voltage gain.
4. To investigate oscillator circuits (Wien Bridge and RC Phase Shift) using op-amps, and calculate the frequency of oscillations theoretically and experimentally.
5. To implement and analyze op-amp applications such as summing amplifier, comparator, zero-crossing detector, and Schmitt trigger, including threshold voltage measurements.
6. To study the operation of IC 555 timer in astable mode and verify timing parameters such as frequency and duty cycle through practical implementation.

Lab Outcomes:

After the successful completion students should be able to

1. Analyze and interpret the frequency response of single-stage and Cascode MOSFET amplifiers, identifying bandwidth, gain, and the effect of cascading stages.
2. Measure and compare the input and output impedance of a CS amplifier, and evaluate the role of feedback in modifying impedance characteristics.
3. Demonstrate the ability to configure and operate op-amps in inverting, non-inverting, differential, and instrumentation amplifier modes with accurate gain calculation.
4. Calculate the frequency of oscillation in Wien bridge and RC phase shift oscillators and validate it through experimental results.

5. Implement and test op-amp-based analog circuits including summing amplifier, comparator, zero-crossing detector, and Schmitt trigger, and determine key parameters like threshold voltages.
6. Design and analyze an astable multivibrator using IC 555 timer, accurately computing and verifying the frequency and duty cycle of the output waveform.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	**Electronic Devices Lab**		
1	To implement single stage MOSFET CS amplifier and study its frequency response	2	LO1
2	To implement a CS-CG MOSFET Cascode amplifier and study its frequency response.	2	LO1
3	To determine input and output impedance of a CS amplifier with and without feedback.	2	LO2
4	To measure parameters of Op-amp.	2	LO3
5	Study of IC 741 Op-Amp – Pin Diagram and Functional Description	2	LO3
6	To study Inverting and Non-inverting configuration of Op-amp.	2	LO3
7	To study Op-amp as a differential amplifier.	2	LO3
8	To study and calculate frequency of oscillations of Wien bridge oscillator	2	LO4
9	To study and calculate frequency of oscillations of RC Phase shift oscillator	2	LO4

10	To study voltage gain of three Op-amp instrumentation amplifier	2	LO5
11	To study the operational amplifier as a summing amplifier.	2	LO5
12	To determine upper and lower threshold voltage in Schmitt trigger using IC 741.	2	LO5
13	Study of inverting and Non-inverting comparator using Op-amp	2	LO5
14	To study and implement an Astable multi-vibrator using a 555 timer IC.	2	LO6
15	To study Op-amp as comparator and zero crossing detector	2	LO6

Text Books:

1. David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.
2. Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", 2nd edition, PHI, 1995
3. Mithal. G.K, "Practicals in Basic Electronics", G K Publishers Private Limited, 1997.
4. Sergio Franco, "Design with operational amplifiers &analog integrated circuits", Tata McGraw Hill, 3rd edition
5. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th Edition.

Online Resources:

Sr. No.	Website Name
1.	https://www.allaboutcircuits.com/
2.	https://www.tinkercad.com/
3.	https://www.circuitlab.com/

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 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 and practical examination will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
13212405	IDEA LAB - IV (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212405	IDEA LAB – IV (Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme- based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

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c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

1. **Motivating and Inspiring Students**
   - Encourage students to take ownership of their learning and projects.
   - Cultivate a mindset of curiosity, exploration, and social relevance.
   - Foster an environment where students feel empowered to take creative risks.
2. **Conducting Brainstorming and Ideation Sessions**
   - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
   - Promote collaborative thinking, design exploration, and interdisciplinary integration.
3. **Arranging Guest Lectures and Expert Talks**
   - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
   - Facilitate exposure to real-world challenges, current trends, and future opportunities.
4. **Ensuring Uniqueness and Originality of Projects**
   - Actively review proposed ideas to ensure **no duplication of solutions** across students.
   - Encourage students to explore novel approaches, technologies, and perspectives.
5. **Promoting Discussion and Collaborative Learning**
   - Create platforms for students to present, discuss, and receive peer and mentor feedback.

- Facilitate idea refinement through regular discussions and group engagement.

6. **Aligning Subject Content Beyond Syllabus**
   - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
   - This ensures relevance, depth, and meaningful interdisciplinary integration.
7. **Same Semester Faculty Requirement**
   - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
8. **Monitoring and Documentation**
   - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
   - Provide ongoing feedback and ensure project alignment with learning outcomes.
9. **Coordination with Subject Faculty**
   - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
   - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	**Faculty in-charges assigned based on project nature and department capacity.**
Mentoring Role	**Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.**
Capacity Building	**Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.**
Assessment Contribution	**Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.**

Aspect	Implementation Strategy
Recognition & Incentives	**Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.**

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b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	**Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.**
Independent Evaluation	**Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a** separate 25 marks allocated for termwork based on subject **application.**
Evidence Sources	**Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.**
Outcome Assurance	**Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.**

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
  - Logbooks
    - Subject-specific outputs (e.g., simulations, designs)
    - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self- motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks) Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	**Marks**	**Description**
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

Course Code	Course Name	Teaching Scheme (Contact Hours)			Teaching Scheme (Contact Hours Per Semester)					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
13412406	**Skill base Lab - Java**	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13412406	**Skill base Lab- Java**	--	--	--	--	25	25	50

Lab Objectives:

Lab course aims to

1. To understand Object Oriented Programming basics and its features.
2. To understand and apply Object Oriented Programming (OOP) principles using C++
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
4. Able to use a programming language to resolve problems.

Lab Outcomes:

After the successful completion students should be able to

1. Use different control structures.
2. Understand fundamental features of an object-oriented language: object classes and interfaces, exceptions and
3. Understand the fundamentals of libraries of object collections.
4. Understand Java Programming.
5. To develop a program that efficiently implements the features and packaging concept of java in the laboratory.
6. To implement Exception Handling and Applets using Java.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	• **Fundamentals of C-Programming • Control Structures • Arrays and String**		
1	Display addition of number	2	LO1
2	Accept marks from user, if Marks greater than 40,declare the student as “Pass” else “Fail””	2	LO1
3	Accept 3 numbers from the user. Compare them and declare the largest number (Using if-else statement).	2	LO2
4	Display sum of first 10 even numbers using do-while loop.	2	LO3
5	Display Multiplication table of 15 using a while loop.	2	LO3
6	Display Multiplication table of 15 using a while loop.	2	LO3
7	Display the sum of elements of arrays.	2	LO4

8	Accept and display the string entered and execute at least 5 different string functions on it.	2	LO4
9	Read and display the numbers as command line Arguments and display the addition of them	2	LO5
10	Define a class, describe its constructor, overload the Constructors and instantiate its object	2	LO6
11	Illustrate method of overloading	2	LO6
12	Demonstrate Parameterized Constructor	2	LO6
13	Implement Multiple Inheritance using interface	2	LO6
14	Create thread by implementing 'runnable' interface or creating 'Thread Class.	2	LO6
14	Demonstrate Hello World Applet Example	2	LO6
15	Write a Java program for handling mouse events	2	LO6

Online Resources:

Sr. No.	Website Name
1.	**J-Edit/J-Editor/Blue J**
2.	**CodeBlock:http://www.codeblocks.org/**
3.	**Netbeans:https://netbeans.org/downloads/**
4.	**Eclipse: https://eclipse.org/**
5.	**Raptor-Flowchart Simulation:http://raptor.martincarlisle.com/**

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 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 and practical examination will be held based on the above syllabus.

Recommended Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, 10th Edition,2017.

2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI, 2009.

3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified ModelingLanguageser Guide", Pearson Education.

4. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010

R-2025- S.E (Sem IV) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Teaching Scheme (Contact Hours Per Semester)					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
9951149 WW	Open Elective	2	-	-	30	-	-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
9951149 WW	Open Elective	--	--	--	--	--	25	--	25

Students must select a course for Open Elective from a bucket provided by the Rahul Education Group.

Term Work Assessment: 25 Marks (Total marks) = 15 Marks (Case Study/Activity) + 5 Marks (Assignments) + 5 Marks (Attendance)

R-2025- S.E (Sem IV) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30
98451410	Design Thinking	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98451410	Design Thinking	20	20	40	60	2.5	--	--	100

Rationale:

Design Thinking is a human-centered approach that fosters creativity, empathy, and problem-solving. This course equips students with tools to understand user needs, generate innovative ideas, and develop practical solutions for real-world challenges.

Course Objectives:

1. Introduce the core principles and stages of the Design Thinking process.
2. Develop an empathetic mindset to understand user needs.

3. Frame clear problem statements using user-centered tools.
4. Apply ideation techniques to generate creative solutions.
5. Understand various types of prototypes and their role in product development.
6. Learn the process of testing and refining ideas based on feedback.

Course Outcomes:

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

1. Compare traditional and design thinking-based approaches to problem solving.
2. Define user personas using empathy and mapping techniques.
3. Frame actionable problem statements using POV and problem definition tools.
4. Apply ideation techniques to develop diverse solution sets.
5. Differentiate between low and high-fidelity prototypes and understand their usage.
6. Explain how to test prototypes based on desirability, feasibility, and usability.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Fundamentals of communication and leadership skills		
I	**Introduction to Design Thinking**	**Introduction to Design Thinking:** Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)	4	CO1
		Self-learning Topics: Design thinking case studies from various domains.	4	

		Link: https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index		
II	**Empathy**	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.	5	CO2
		Self-learning Topics: Creation of empathy maps **Link:** https://www.interaction-design.org/literature/topics/empath y-mapping **Case Study:** Designing MRI for Children – GE Healthcare	5	
III	**Define**	Significance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV	5	CO3
		Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples **Link:** https://uxpressia.com/blog/how-to-create- persona-guide-examples	5	
IV	**Ideate**	What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi-disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind	6	CO4

		mapping		
		Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide **Link:** https://uxplanet.org/how-to-run-an-effective- ideation-workshop-a-step-by-step-guide-d520e41b1b96	6	
V	**Prototype**	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario Prototype.	4	CO5
		Self-learning Topics: IDEO Prototyping Toolkit	4	
VI	**Test**	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	6	CO6
		Self-learning Topics: Real-world Testing Examples from Stanford d.school or IDEO **Case Study:** IDEO's Shopping Cart Redesign – A classic innovation sprint (All stages)	6	
Total			30	

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin, Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013

2. Change by Design, Tim Brown, Harper Business, 2009

Online References:

Sr. No.	Website Name
1.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
2.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

R-2025- S.E (Sem IV) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (National Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431411	Business Model Development	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98431411	Business Model Development	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is the backbone of innovation and economic growth. In the 21st-century knowledge economy, students must be equipped not just with employment-ready skills but with a problem-solving and innovation mindset to become job creators. This course blends core entrepreneurship principles with business model design, startup financing, and digital business strategies.

Course Objectives:

1. To introduce students to entrepreneurship and its socio-economic relevance.
2. To enable understanding of different business structures and MSME significance.
3. To familiarize learners with funding mechanisms for startups.
4. To introduce the basics of IPR and ethical innovation practices.
5. To equip students with tools for building business models and MVPs.
6. To explore digital marketing and disruption in online business ecosystems.

Course Outcomes:

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

1. Define and explain entrepreneurship and its key types.
2. Analyze the legal and operational structure of business ownership.
3. Identify and compare startup funding models and sources.
4. Apply the fundamentals of IPR to protect entrepreneurial innovations.
5. Create comprehensive business models using BMC tools.
6. Evaluate and apply digital marketing techniques for online business models.

Prerequisite: Basic Design Thinking principles.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Basic Design Thinking principles		
I	**Introduction to Entrepreneurship**	Definition, the role of entrepreneurship in the economic development, The entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset.	5	CO1
		Self-learning Topics: Case studies: Henry Ford	5	

		https://www.thehenryford.org/do cs/default- source/default-document-library/default-document-library/henryfordandinnovation.p df?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business		
II	**Entrepreneurship Development**	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development.	4	CO2
		Self-learning Topics:MSME Act and Udyam Registration portal **Case Study:** Amul – Co-operative innovation in dairy sector	4	
III	**Start-up financing**	**Start-up financing:** Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes funding(e.g., SIDBI, Startup India).	5	CO3
		Self-learning Topics: Successful business pitching. **Case Study:** Shark Tank pitch breakdown.	5	
IV	**Intellectual Property Rights (IPR)**	Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation.	5	CO4

		Self-learning Topics: Case Study: WIPO Patent Search Exercise	5	
V	**Business Model Development**	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.	6	CO5
		Self-learning Topics: The Art of the Start 2.0: The Time- Tested, Battle- Hardened Guide for Anyone Starting Anything by Guy Kawasaki **Case Study:** The Rise of Zomato – A Disruptive Food Delivery Platform	6	
VI	**Digital Business Management**	Digital Business models (Subscription, Freemium *etc*), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business.	5	CO6
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	5	
Total			30	

Sr No	List of Assignments	Hrs
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
3.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
4.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/
5.	WIPO Patent Search https://www.wipo.int/portal/en/index.html
6.	Airbnb Business Model Case https://www.prismetric.com/airbnb-business-model/
7.	BMC Tool https://www.strategyzer.com/canvas/business-model-canvas

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance).