Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified | DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

Shree Rahul Education Society's (Regd.)

Shree L.R. Tiwari College of Engineering

Shree L.R. Tiwari Educational Campus,

Mira Road–East, Thane-401107.

Maharashtra, India

www.slrtce.in

An Autonomous Institute Affiliated to the University of Mumbai

Department of Electronics and Computer Science

Curriculum TY A.Y 2026-27

Third Year Syllabus

Revision: R-2025

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 mindset 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-centric 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, socio-economic 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 impactful 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 centred 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 instil 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,

Principal
SLRTCE

COO
Rahul Education

PREFACE(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 industryoriented, 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 cyberphysical 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 ECS 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

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
EMC	Entrepreneurship/economics/management courses
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
OE	Open Elective
OJT	On Job Training
P	Practical
PROJ	Project
PCC	Program Core Course
PCCL	Program Core Course Lab
PEC	Program Elective Course
RM	Research Methodology
SL	Self-Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

Curriculum Structure and Examination Scheme for B.Tech. in Electronics and Computer Science
(FY with Effect from AY 2026-2027) Curriculum Structure – TY Semester-V

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)	Examination Scheme				Exam Duration for Theory (in Hrs.)	Term Work	Practical / Oral	Total
												In-Semester Assessment			End Semester Exam (ESE)				
			L	T	P	L	T	P	SL	Notional Learning		IAT-I	IAT-II	Total					
13211501	PCC	Database Management System	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
13211502	PCC	Microcontroller & Embedded System	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
13211503	PCC	Web Technology	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
13212504	PCC LAB	DBMS&WT Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
13212505	PCC LAB	Microcontroller & Embedded System Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
13212506	PCC LAB	IDEA Lab - V	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
1322157xx	PEC-I	Elective Bucket	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
9931158ww	MDM-II	MDM Bucket	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
13412509	VSEC	Linux Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	--	25
99512510xx	OE-III*	OE Bucket	2	--	--	30	--	--	30	60	2	--	--	--	--	--	25	--	25
Total			**17**	**–**	**8**	**285**	**–**	**90**	**285**	**630**	**21**	**100**	**100**	**200**	**300**	**12.5**	**125**	**2.5**	**700**

Program Elective Course -I	
Course Code	**Name of the Course**
132215701	Basic Semiconductor for VLSI
132215702	Data compression
132215703	Computer Networks
132215704	Foundation of data Science

Open Elective-III	
Course Code	**Name of the Course**
9951251001	Corporate Finance
9951251002	Economics of Banking and Finance Markets
9951251003	HR Analytics
9951251004	International Financial Management
9951251005	Marketing Management - I
9951251006	Operations and Supply Chain Management
9951251007	Principles of Behavioral Economics
9951251008	Quantitative Investment Management

Students who achieve a CGPI of 7.5 or higher by the end of the semester VI are eligible to pursue an additional 18 credits from the semesters V to VIII to qualify for a B. Tech degree with Honors.

Curriculum Structure and Examination Scheme for B.Tech. in Electronics and Computer Science (TY with Effect from AY 2026-2027) Curriculum Structure – TY Semester-VI

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)	Examination Scheme				Exam Duration for Theory (in Hrs.)	Term Work	Practical / Oral	Total
												In-Semester Assessment			End Semester Exam (ESE)				
			L	T	P	L	T	P	SL	Notional Learning		IAT-I	IAT-II	Total					
13211601	PCC	AI ML	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
13211602	PCC	Software Engineering	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
13211603	PCC	Data Warehousing and Mining	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
13212604	PCC LAB	AI ML Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
13212605	PCC LAB	DWM & Software Engineering Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
13812606	Project	Dissertation-I	--	--	2	--	--	30	--	30	1	--	--	--	--	--	50	50	100
1322167xx	PEC-II	Elective Bucket	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
9931168ww	MDM-III	MDM Bucket	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
98451609	VEC	Professional communication Ethics-II	2	--	--	30	--	--	30	60	2	–	–	–	–	–	25	–	25
99512610xx	OE-III*	OE Bucket	2	--	--	30	--	--	30	60	2	–	–	–	–	–	25	--	25
Total			**19**	**--**	**6**	**285**	**--**	**90**	**285**	**660**	**22**	**100**	**100**	**200**	**300**	**12.5**	**150**	**100**	**750**

Program Elective Course -II	
Course Code	**Name of the Course**
132216701	ASIC Verification
132216702	Network and security
132216703	Advanced Networking Technology
132216704	Statistical Learning for Data science

Open Elective-IV	
Course Code	**Name of the Course**
9951261001	Cultural Studies Language for Competitive Exams
9951261002	Direct foreign language courses (like German, French)
9951261003	Ethics in Engineering Practice,
9951261004	Financial Institutions and Markets
9951261005	Introduction to Psychology
9951261006	Introduction to Sociology
9951261007	Investment Management
9951261008	Moral Thinking: Introduction to Values and Ethics,

Note:

1. Questions based on self-learning must not be asked in internal assessment and End semester Exam

2. 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.

3. 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

4. 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 term work and practical will have no assessment on self-learning topics. This may involve laboratory work using the latest tools or preparing technical write-ups/research papers on advanced topics.

SEM V

Semester – V

Theme: Urban Systems

Aligned with UNSDG: SDG 3 – Good Health and Well-being, SDG 6 – Clean Water and Sanitation, SDG 7 – Affordable and Clean Energy, SDG 9 – Industry, Innovation and Infrastructure, SDG 11 – Sustainable Cities and Communities, SDG 12 – Responsible Consumption and Production, SDG 13 – Climate Action, and SDG 16 – Peace, Justice and Strong Institutions under United Nations.

Problem Statement 1:

To study challenges in urban systems and demonstrate a system for improved service efficiency.

Problem Statement 2:

To observe urban resource usage and demonstrate a system for better coordination.

Problem Statement 3:

To study urban service practices and demonstrate a system supporting sustainability

Problem Statement 4:

To observe operational patterns in urban environments and demonstrate a system for improvement

Problem Statement 5:

To study urban infrastructure needs and demonstrate a system for better management.

Problem Statement 6:

To study mobility-related challenges in urban environments and explore approaches that improve movement and accessibility.

Problem Statement 7:

To investigate the interaction between urban services and citizens and identify opportunities for improved service delivery.

Problem Statement 8:

To observe public service usage and demonstrate a very basic system for efficient operation.

Problem Statement 9:

To study urban system behavior and demonstrate a very basic system supporting organized functioning.

Problem Statement 10:

To observe service-related challenges in urban areas and demonstrate a very basic system for enhancement.

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	
13211501	**Database Management System**	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211501	**Database Management System**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: Database Management Systems (DBMS) form the backbone of modern information systems by enabling efficient storage, retrieval, and management of data. This course provides students with fundamental knowledge of database concepts, data modeling, and query languages essential for developing real-world applications. It emphasizes both theoretical foundations and practical skills such as database design, SQL programming, and data integrity management. Understanding DBMS is crucial for building scalable, secure, and reliable software systems across domains like banking, e-commerce, healthcare, and enterprise applications.

Course Objectives:

1. To introduce fundamental concepts of database systems, data models, and database architecture.
2. To develop the ability to design ER/EER models and map them to relational schemas.
3. To understand relational model concepts, integrity constraints, and relational algebra operations.
4. To enable students to use SQL for data definition, manipulation, and control.

5. To impart knowledge of database design techniques using functional dependencies and normalization.
6. To familiarize students with transaction management, concurrency control, and recovery mechanisms.

Course Outcomes:

1. Explain fundamental concepts of DBMS, data models, and database architecture.
2. Design ER/EER diagrams and transform them into relational schemas.
3. Apply relational model concepts, integrity constraints, and relational algebra operations.
4. Write and execute SQL queries using DDL, DML, DCL, TCL, joins, and nested queries.
5. Apply normalization techniques and functional dependencies to design efficient databases.
6. Analyze transaction management, concurrency control, and recovery mechanisms in DBMS.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Database Management Systems, Probability & Statistics, Basic Programming Concepts		
1	Introduction to DBMS	Overview of DBMS File System vs DBMS Advantages of DBMS Database System Architecture (1-tier, 2-tier, 3-tier) Data abstraction and Data Independence Database Users and Database Administrator	07	CO1
		Self-Learning: Need for DBMS in modern applications Data Models: Hierarchical, Network, Relational Applications (banking, railway, e-commerce) DBMS vs RDBMS Introduction to NoSQL (types: document, key-value)	07	

2	**Entity–Relationship Data Model**	ER Model: Entities, Attributes, Relationships Keys and their types Constraints: Cardinality, Participation ER Diagram design problems EER Model: Generalization, Specialization, Aggregation	07	CO2
		Self-Learning: Real-world ER design case studies Weak entity sets and advanced constraints	07	
3	**Relational Model and Relational Algebra**	**Part A: Relational Model** Relational schema, tables, tuples, attributes Types of keys Integrity constraints: Domain Entity integrity Referential integrity Key Constraints, NOT NULL, UNIQUE, CHECK, DEFAULT Mapping ER → Relational Model Pitfalls in design **Part B: Relational Algebra** Introduction to Relational Algebra Fundamental Operations Derived Operations	08	CO3
		Self-Learning: Case studies on schema design Surrogate keys vs natural keys	08	
4	Structured Query Language (SQL)	SQL Overview DDL, DML, DCL, TCL commands Joins (inner, outer), nested queries Aggregate functions, GROUP BY, HAVING Views and triggers Complex queries Mapping SQL with Relational Algebra	08	CO4
		Self-Learning: Comparison of SQL vs Relational Algebra Query optimization basics	08	

		Use of SQL in real applications (web apps, ERP systems) Build a **small database application** (library / student system) using SQL		
5	**Relational–Database Design & Normalization**	Concept of normalization Functional Dependency (FD) Types of FD Anomalies (Insertion, Deletion, Update) Normalization Techniques: 1NF 2NF 3NF BCNF	07	CO5
		Self-Learning: Normalize a given unstructured dataset step-by-step up to BCNF Identify real-life anomalies in poorly designed databases Compare normalized vs denormalized databases in applications Study case studies of database design in industry systems	07	
6	**Transaction Management, Concurrency and Recovery**	T**ransactions:** Concept, transaction states and lifecycle, ACID properties, transaction control commands. **Concurrency Control:** Issues in concurrent transactions (lost update, dirty read, inconsistent retrieval), locking mechanisms, basic idea of serializability. **Recovery System:** Log-based recovery, checkpoints, deadlock handling (prevention and detection).	08	CO6
		Self-Learning: Analyze banking/ATM transaction scenarios for concurrency issues Study how real DBMS handle Explore deadlock situations and possible solutions with examples Understand how data recovery works after system failure (logs, checkpoints)	08	
	Total		90	

Text Books:

1. 1.Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson education.
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH.

References:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5th Edition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill., 2012.
4. Ben Forta, *SQL in 10 Minutes a Day*, Sams Publishing.
5. Martin Kleppmann, *Designing Data-Intensive Applications*, O'Reilly

Online References:

1. **NPTEL – Data Base Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay (IIT Kharagpu)** https://onlinecourses.nptel.ac.in/noc22_cs91/preview.
2. **Database System Concepts, Seventh Edition** https://www.db-book.com/
3. Coursera course on DBMS https://www.tutorialspoint.com/dbms/index.htm.

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks

2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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	
13211502	Microcontroller and Embedded system	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211502	Microcontroller and Embedded system	20	20	40	60	2.5	--	--	100

Rationale: The course is designed to provide students with a strong foundation in microprocessors and microcontrollers, progressing from basic architectural concepts to practical embedded system design. Since students have prior knowledge of digital electronics and computer organization, the syllabus emphasizes application-oriented learning through programming, interfacing, and system-level design.

The inclusion of both assembly language and Embedded C enables students to understand low-level hardware control as well as modern software development practices. Topics such as communication protocols, real-time operating systems, and modern controller platforms (Arduino/ARM) ensure alignment with current industry requirements.

The course also integrates practical and case study-based learning to develop problem-solving skills and prepare students for real-world embedded system applications in domains such as automation, IoT, and smart devices.

Course Objectives:

1 To understand the fundamentals of microprocessors and microcontrollers.
2 To develop assembly language programming skills for microcontrollers.
3 To learn Embedded C programming for modern embedded platforms.
4 To understand embedded system concepts and design methodology.
5 To apply interfacing techniques and communication protocols in embedded systems.

6 To understand RTOS concepts for real-time embedded applications.

Course Outcomes:

CO1: Explain microprocessor and microcontroller architecture.
CO2: Apply microcontroller concepts to develop assembly programs.
CO3: Develop embedded applications using Embedded C.
CO4: Analyze embedded systems and their design process.
CO5: Apply interfacing techniques and communication protocols
CO6: Explain and analyze RTOS concepts in embedded systems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Digital Electronics, Computer Organization and Architecture		
1	Microprocessor and Microcontroller Fundamentals	1.1 Microprocessor vs Microcontroller (quick recap) 1.2 Overview of embedded processors (8-bit, 16-bit, 32-bit) 1.3 Basic architecture of microprocessor (8086 concept only) 1.4 Introduction to microcontrollers 1.5 Internal architecture of a generic MCU (CPU, memory, I/O, buses)	07	CO1
		Self-Learning: Difference between RISC and CISC (in detail) Case study: Intel vs ARM processors Study of latest microcontrollers used in IoT	07	
2	Microcontroller Architecture & Programming	2.1 Architecture of 8051 (or generic MCU model) 2.2 Memory organization and Special Function Registers 2.3 Addressing modes 2.4 Instruction set overview 2.5 Assembly programming concepts: ● Data transfer, arithmetic, logical ● Looping, branching ● Stack and subroutines	08	CO2

		2.6 Timer, interrupt, serial communication basics		
		Self-Learning: Write ALP for sorting/searching Interrupt-based program examples Study: Limitations of 8051 vs modern MCUs	08	
3	Embedded C & Modern Controllers	3.1 Need of Embedded C over Assembly 3.2 Structure of Embedded C program 3.3 GPIO programming concepts 3.4 Basics of Arduino / ARM Cortex-M 3.5 Simple interfacing using Embedded C	07	CO3
		Self-Learning: Arduino IDE installation & practice Write program for LED blinking Compare Embedded C vs Python	07	
4	Embedded System Fundamentals & Design	4.1 Embedded system definition & characteristics 4.2 Classification (real-time, IoT-based, distributed) 4.3 Design metrics (cost, power, performance) 4.4 Embedded system design flow: 4.5 Requirement → design → implementation → testing 4.6 Case studies (home automation, smart devices)	08	CO4
		Self-Learning: Analyze any embedded product (report) IoT system architecture study Prepare case study presentation	08	
5	Interfacing & Communication Protocols	5.1 Sensors and actuators basics 5.2 Interfacing techniques 5.3 Communication protocols: ● UART, SPI, I2C (core focus) ● CAN (intro) 5.4 Basics of IoT communication: Wi-Fi, Bluetooth 5.5 Data exchange in embedded systems	08	CO5
		Self-Learning: ● Study Bluetooth & Wi-Fi modules ● Arduino serial communication practice ● Intro to MQTT protocol	08	

6	Real-Time Systems & Applications	6.1 Introduction to real-time systems 6.2 Hard vs soft real-time systems 6.3 Need of RTOS 6.4 Concepts: ● Task, scheduling, multitasking ● Context switching 6.5 Basic scheduling algorithms (conceptual) 6.6 Introduction to FreeRTOS (demo level) 6.7 Application-based learning	07	CO6
		Self-Learning: Case study: Automotive real-time system FreeRTOS basic tutorials ● RTOS vs General OS comparison	07	
	Total		90	

Text Books

1 The 8051 Microcontroller, Kenneth J. Ayala, Cengage Learning, 3rd Edition 2007
2 The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Mazidi, M. A., Mazidi, J. C., McKinlay, Rolin D, Pearson India, 2nd Edition 2012
3 Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGrawHill Education (India) Private Ltd. 3rd Edition 2017.
4 Embedded Real Time Systems: Concepts, Design & Programming Prasad, K. V. K. K Dreamtech Press, 2nd Edition 2014

Online References:

1 NPTEL https://nptel.ac.in/courses 1-6
2 www.udemy.com https://www.udemy.com -8051-microcontroller/ 1-2
3 https://openlabpro.com https://openlabpro.com/online- courses/embedded-systems/ 4-6

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.

- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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	
13211503	Web Technology	03	--	--	45	--	--	45-	90	03

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT -I	IAT-II	Total					
13211503	Web Technology	20	20	40	60	2.5	--	--	100

Rationale: Web technologies provide the tools and infrastructure to create, deploy, and manage websites and web applications, enabling communication and information sharing across the internet. They encompass a wide range of aspects, including web design, development, servers, browsers and e-commerce platforms.

Course Objectives:

1.Understand core web development technologies including HTML, CSS, JavaScript, and server-side scripting.
2.Integrate AI services or models to create dynamic and context-aware user experiences.
3.Apply principles of responsive and accessible design.
4.Utilize real-time data, APIs, and user inputs for personalization.
5.Align technical development with social responsibility goals such as water conservation.

Course Outcomes:

1.Design static web pages using HTML5. (Design).
2.Design responsive front-end interfaces for public awareness. (Design).
3.Develop client-side validation and scripts to static web pages (Develop).

3.Develop client-side validation and scripts to static web pages (Develop).
4.Deploy and test a functional website using industry-standard tools and hosting using Bootstrap. (Deploy/Test).
5.Construct dynamic web pages using server-side scripting (Creating).
6.Develop a web application using appropriate web development framework (Develop).

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basics of programming languages, Basic knowledge of HTML		
1	**Introduction to HTML5**	Basic structure of an HTML5 document, creating an HTML5 document, Markup Tags, Heading-Paragraphs, line Breaks HTML5 Tags - Introduction to elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia, Forms and other HTML5 controls.	07	CO1
		Self-Learning: Semantic HTML5 Tags <header>, <nav>, <section>, <article>, <footer> HTML Attributes HTML Entities Div and Span Meta Tags HTML5 based game development.	07	
2	**Static Web Page Design**	Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties). CSS Advanced: (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class,	07	CO2

		Navigation Bar, Image Sprites, Attribute sector).		
		Self-Learning: CSS Comments CSS Colors CSS Overflow CSS Cursor CSS Media Queries (Responsive Design)	07	
3	**Client-side scripting**	JavaScript:Introduction to JavaScript, Lexical Structure, Types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Scripting CSS, Handling Events. jQuery: jQuery Basics, jQuery Getters and Setters, Altering Document Structure, Handling events with jQuery, Animated Effects, Utility functions, jQuery Selectors and Selection Methods, Extending jQuery with Plug-ins, The jQuery UI Library	08	CO3
		Self-Learning: JavaScript Comments DOM Manipulation Basics ES6 Features (Modern JavaScript) Form Validation AJAX with jQuery Debugging & Developer Tools Mini Project: **Student To-Do List Manager**	08	
4	**Bootstrap**	Introduction to Bootstrap, downloading and installing	07	CO4

		Bootstrap. The Grid System: Introducing the Grid, Offsetting and Nesting, Responsive Features, Utility Classes, and Supported Devices.CSS Foundations: Typography in Bootstrap, Styling Tables, Styling Forms, Styling Buttons, Images, icons, and Thumbnails. Navigation Systems: Tabs, Pills, and Lists, Breadcrumbs and Pagination, Navigation Bar, Making the Navigation Bar Responsive. JavaScript Effects: Drop-downs, Modal Windows, Tooltips and Popovers, Navigation Aids: Tabs, Collapse, Affix, Carousel.		
		Self-Learning: Bootstrap Cards Bootstrap Alerts Bootstrap Badges Bootstrap Progress Bar Bootstrap Carousel (Slider) Mini Project: **College Website Homepage (Bootstrap)**	07	
5	**Server side-scripting-ng:**	Introduction to PHP, PHP Tags. Adding Dynamic content, Accessing form variables, Identifiers, user-declared variables, Data types, Constants, Operators, Control structures, Conditionals, Iteration constructs, Using arrays, string manipulation and regular expressions, reusing code and writing, functions, Designing and creating your web database, Accessing MySQL database from the Web with PHP, Session Control in PHP.	08	CO5
		Self-Learning: PHP Cookies File Handling in PHP PHP Include & Require Error Handling in PHP	08	

		PHP Date and Time Functions Mini Project: **Online Feedback System (PHP + MySQL)**		
6	**Web Development Framework**	MVC architecture - Introduction and applications Server side-scripting – Laravel Framework Managing Your Project Controllers, Layout, Views, and Other Assets, Talking to the Database, Model Relations, Scopes, and Other Advanced Features, IntegratingWebForms, Authenticating and Managing Your Users, Deploying, Optimizing and Maintaining Your Application	08	CO6
		Self-Learning: Routing in Laravel, Middleware in Laravel, RESTful APIs in Laravel	08	
	Total		90	

Text Books:

1.Ralph Moseley, M.T. Savliya, “Developing Web Applications”, Willy India, Second Edition,
2.“Web Technology Black Book”, Dreamtech Press, First Edition, 978-7722-997.
3.Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY,2014.(http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascript_CSS_HTML5_Robin_Nixon_3e.pdf).
4.Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward, Benson, Wiley publications. **https://ebooks-it.org/0470082801-ebook.htm**.
5.Jennifer Kyrnin, “SAMS Teach Yourself Bootstrap in 24 hours”, 1st edition, Pearson Education.
6.Martin Bean, “Laravel 5 Essentials”, PACKT Publishing Ltd.

References:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.

4. David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011.
5. Steven Holzner, "The Complete Reference – PHP", Tata McGraw Hill, 2008.
6. Mike Mcgrath, "PHP & MySQL in easy Steps", Tata McGraw Hill, 2012.
7. J. Millman and A. Grabel, "Head First HTML and CSS", 2nd edition, O" Reilly.
8. Ben Frain, "Responsive Web design with HTML5 and CSS3", PACKT Publishing Ltd.
9. L. Welling and L. Thomson, "PHP and MySQL Web Development", 4th edition, Adison Wesley Professional.

Online References:

Sr. No.	**Website Name**
1.	www.nptelvideos.in
2.	www.w3schools.com
3. .	http://spoken-tutorial.org

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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	
13212504	**DBMS & WT Lab**	**--**	**--**	2	--	--	30		30	**1**

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13212504	**DBMS & WT Lab**	--	--	--	--	**--**	25	25	50

Lab Objectives:

1. To understand the fundamental concepts of database design, including entity–relationship (ER/EER) modeling and their transformation into relational schemas.
2. To develop practical skills in creating and managing databases using SQL Data Definition Language (DDL) and Data Manipulation Language (DML) commands.
3. To learn how to retrieve and manipulate data effectively using SQL queries, including joins, nested queries, and aggregate functions.
4. To gain knowledge of advanced database mechanisms such as triggers and transaction control for maintaining data integrity and consistency.
5. To understand and apply form design, input validation, and basic programming concepts using HTML, JavaScript, and PHP.
6. To explore the development of responsive and user-friendly web interfaces using Bootstrap.

Lab Outcomes:
After the successful completion students should be able to

1. Design and model database systems using ER/EER diagrams and convert them into relational schemas.
2. Create and manage databases using DDL and DML commands and apply integrity constraints.
3. Perform data manipulation and retrieval using SQL queries, including joins and aggregate functions.
4. Implement advanced database features such as triggers and transaction control to ensure data consistency.
5. Develop web forms and perform validation, calculations, and dynamic data display using HTML, JavaScript, and PHP.
6. Design responsive and user-friendly web pages using Bootstrap.

DETAILED SYLLABUS

1	To design an Entity–Relationship (ER/EER) diagram for a real-world application by identifying entities, attributes, relationships, and constraints.	LO1
2	To convert the given ER/EER diagram into a relational schema by defining tables, keys, and integrity constraints.	LO1
3	Create Database and Tables using using SQL DDL commands.	LO2
4	To perform data manipulation operations using SQL DML commands such as INSERT, UPDATE, and DELETE on database tables.	LO3
5	To apply integrity constraints such as PRIMARY KEY, FOREIGN KEY, NOT NULL, UNIQUE, and CHECK on database tables.	LO2
6	To perform data retrieval using SQL SELECT queries with WHERE, ORDER BY, and DISTINCT clauses.	LO3
7	To apply aggregate functions (COUNT, SUM, AVG, MAX, MIN) using GROUP BY and HAVING clauses.	LO3
8	To perform data retrieval using different types of joins such as INNER JOIN, LEFT JOIN, and RIGHT JOIN.	LO3
9	To create and execute simple triggers for INSERT and UPDATE operations.	LO4
10	To implement transaction control operations using COMMIT, ROLLBACK, and SAVEPOINT to maintain data consistency.	LO4
11	Design a registration form with: Text fields, radio buttons, checkboxes, and dropdowns	LO5
12	To design and implement a student marks calculator using HTML and JavaScript to calculate the total marks and percentage based on user input.	LO5

13	To implement form validation using JavaScript for validating email format, password length, and matching confirm password.	LO5
14	To create a simple web page using PHP that displays a list of books along with their prices using arrays and looping statements.	LO6
15	To design and implement responsive card layouts using Bootstrap that automatically adjust across different screen sizes such as mobile, tablet, and desktop.	LO6

Text Books:

1. **Ramez Elmasri, Shamkant B. Navathe**, *Fundamentals of Database Systems*, Pearson.
2. **Abraham Silberschatz, Henry F. Korth, S. Sudarshan**, *Database System Concepts*, McGraw Hill.
3. **Kogent Learning Solutions Inc.** – *Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET*, Dreamtech Press.
4. **Achyut S. Godbole & Atul Kahate** – *Web Technologies*, McGraw Hill.

References Book:

1. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5th Edition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3. G. K. Gupta, Database Management Systems, McGraw Hill., 2012.
4. Sanjay Saxena – A First Course in Computers, Vikas Publishing.
5. Reema Thareja – Web Technologies, Oxford University Press India.
6. P. K. Sinha & Priti Sinha – Computer Fundamentals, BPB Publications.

Online Resources:

Sr. No.	Website Name
1.	**SQL Online Editor: https://www.w3schools.com/sql/sql_editor.asp**
2.	SQL Online Compiler – https://onecompiler.com/mysql/3xmgv6f2c
3.	W3Schools-Very easy tutorials for HTML, JavaScript, PHP, Bootstrap with examples and “Try it Yourself” editor

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)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
13212505	Microcontroller & Embedded System Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13212505	Microcontroller & Embedded System Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Lab course aims to

1. To enable students to understand the architecture and programming concepts of microcontrollers.
2. To develop assembly language programming skills for basic microcontroller operations.
3. To implement embedded applications using Embedded C programming.
4. To interface sensors, actuators, and peripheral devices with microcontrollers.
5. To implement communication protocols such as UART, SPI, and I2C in embedded systems.
6. To analyze embedded system applications and real-time operating concepts through practical implementation.

Lab Outcomes:

After successful completion of the laboratory work, students will be able to:

1. **Understand:** Explain microcontroller architecture and basic programming concepts.
2. **Apply:** Develop assembly language programs for arithmetic, logical, and control operations.
3. **Apply:** Implement embedded applications using Embedded C programming.

4. **Analyze:** Interface sensors, actuators, and peripheral devices with microcontrollers.
5. **Apply / Analyze:** Implement communication protocols such as UART, SPI, and I2C for data exchange.
6. **Evaluate:** Analyze embedded applications and real-time system concepts using modern embedded platforms.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	**Fundamental Mathematics and Physics**		
1	Study of 8051 microcontroller architecture and development environment**.**	2	LO1
2	Write an assembly language program (ALP) for addition and subtraction of two numbers**.**	2	LO1
3	Write an ALP to perform multiplication or division of numbers**.**	2	LO2
4	Write an ALP for data transfer operations and logical operations**.**	2	LO2
5	Write an ALP to implement looping and branching operations**.**	2	LO2
6	Write an ALP to generate delay using timers in 8051.	2	LO2
7	Write an ALP to demonstrate interrupt handling in 8051.	2	LO2
8	Write an Embedded C program for LED blinking using GPIO (Arduino/8051).	2	LO2
9	Write an Embedded C program to interface push button or switch and control LED.	2	LO3
10	Interface a temperature sensor / LDR sensor with microcontroller and display output.	2	LO5
11	Implement serial communication using UART between microcontroller and PC.	2	LO4
12	Demonstrate I2C or SPI communication between two devices.	2	LO5/LO6
13	Study or demonstration of FreeRTOS / basic task scheduling concept using embedded platform.	2	

References:

1 The 8051 Microcontroller, Kenneth J. Ayala, Cengage Learning, 3rd Edition 2007
2 The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Mazidi, M. A., Mazidi, J. C., McKinlay, Rolin D, Pearson India, 2nd Edition 2012
3 Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGrawHill Education (India) Private Ltd. 3rd Edition 2017.

4 Embedded Real Time Systems: Concepts, Design & Programming Prasad, K. V. K. K Dreamtech Press, 2nd Edition 2014

Assessment:

Term Work shall consist of at least minimum 10 practical based on the above list. Also, the term work journal must include at least 2 assignments.

Term Work 25 marks: 15 Marks (Experiments)+ 5 Marks (Assignment)+ 5 Marks (Attendance)

Oral/Practical: 25 Marks: The practical and oral will be conducted on above experiments and theory syllabus

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	
13212506	IDEA LAB - V -(Innovation Design Engineering and Apply)	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13212506	IDEA LAB - V -(Innovation Design Engineering and Apply)	--	--	--	--	--	25	25	50

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 structured assessment framework is implemented.

1. Project assessment is carried out using standardized IDEA Lab rubrics with multiple evaluation parameters.
2. One of the key parameters is **Engineering Subject-Based Assessment**, which focuses on the effective application of same-semester subject knowledge in project work, ensuring integration of theoretical learning with practical implementation.

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 (Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- 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.

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

- Students must ensure that their IDEA Lab project meaningfully incorporates concepts from all core subjects of the current semester and maintain a project logbook as evidence of subject-wise application.
- Faculty in-charge must guide students to apply concepts from subjects studied in the same semester to their IDEA Lab projects.
- The term work evaluation will partially reflect the effective application of subject-specific knowledge.
- Faculty should regularly review the integration of academic content within the project work.

2) Implementation Strategy – IDEA Lab Learning Model

- A theme-based learning structure shall be implemented where each semester is anchored to a broad contextual domain such as Healthcare, Smart Cities, Energy, Agriculture, or Governance, providing the overall learning direction.
- From the identified theme, a system-level, open-ended problem statement shall be defined, serving as a solution-neutral framework that enables interdisciplinary thinking and innovation.
- The learning sequence shall follow a structured flow:
  Theme → Problem Statement → Same Semester Subject Application →
  Design–Implementation Experience, ensuring progressive transformation from context to solution.
- Themes shall provide the context (defining the domain of work), while problem statements shall provide the purpose, enabling students to identify meaningful real-world challenges.
- Subjects shall be treated as engineering tools, where each subject contributes specific knowledge components to solve different aspects of the problem.

- Students shall be encouraged to take ownership of their learning and projects, fostering curiosity, exploration, social relevance, and a mindset of creative risk-taking.
- Structured brainstorming and ideation sessions shall be conducted at the beginning of the semester to guide students in problem identification and development of solution pathways through collaborative and interdisciplinary thinking.
- Guest lectures and expert talks shall be organized by inviting industry experts, researchers, and innovators aligned with the semester theme and subject areas to provide exposure to real-world challenges, trends, and opportunities.
- A mechanism shall be implemented to ensure uniqueness and originality of projects by systematically reviewing ideas to avoid duplication and encouraging novel, technology-driven solutions.
- Platforms shall be created for collaborative learning and discussion, enabling students to present ideas, receive peer and mentor feedback, and refine solutions through iterative engagement.
- Content beyond syllabus for as subject shall be integrated with IDEA Lab themes and problem statements to ensure deeper interdisciplinary application and enhanced conceptual understanding.
- Preference shall be given to ensuring same-semester academic alignment, where subject faculty contribute to effective contextual integration of project-based learning.
- Continuous monitoring and documentation shall be ensured through logbooks, milestone tracking, and periodic progress reviews to maintain academic rigor and outcome alignment.
- Coordination with subject faculty shall be ensured for effective mapping of theoretical concepts into project execution and for evidence-based term work assessment.
- The IDEA Lab shall function as an institutional mechanism for implementing the CDIO (Conceive–Design–Implement–Operate) framework, promoting experiential and outcome-based learning through structured mini-projects.

Implementation Notes:

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

3) Guidelines for Assessment

Assessment Month	**Marks**
Month 1 (Formative 1)	25marks
Month 2 (Formative 2)	25 marks
Month 3 (Formative 3)	25marks

Total Assessment Structure

Component	Marks	Assessed By
Term work – Project Execution	25 Marks	Project Guide – Average of all innovation
Viva Voce (Final Evaluation)	25 Marks	External Examiner

Criteria	**Excellent (10)**	**Good (8)**	**Satisfactory (6)**	**Needs Improvement (4)**
1. Innovation	Highly original and disruptive idea solving a real-world or futuristic problem	Novel idea with a creative approach to a known problem	Moderately innovative; adapts existing solutions	Common or repetitive idea with minimal novelty
2. Design	User-centric, systematic design with professional-level tools, prototyping, or simulations	Logical structure; clearly presented using standard tools	Functional design but limited user perspective or refinement	Poor or confusing design with lack of user consideration
3. Engineering	Applies concepts from all same-semester subjects with clear integration and interdisciplinary depth	Applies knowledge from 4 or more subjects with relevance	Applies 2–3 subjects with moderate clarity	Applies 1 subject with weak or shallow connection
4. Implementation	Complete, fully functional prototype with rigorous testing and real-world validation	Working model with minor errors; partially tested	Prototype is incomplete; basic testing or debug attempt	Poorly implemented; fails to function properly

5. Application	Strong real-world relevance with alignment to SDGs/National Missions; impact clearly identified	Clear practical use-case with user/market relevance	Some practical value but limited clarity on impact	Vague or irrelevant application; weak user connect

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	
132215701	**Basic Semiconductor for VLSI**	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- I	IAT-II	Total					
132215701	**Basic Semiconductor for VLSI**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: This course provides the foundational knowledge required for VLSI design and semiconductor engineering by introducing semiconductor materials, MOS devices, CMOS technology, fabrication processes, and integrated circuit manufacturing concepts. The course bridges the gap between basic electronic devices and advanced VLSI system design, enabling students to pursue higher-level courses and careers in semiconductor and integrated circuit industries. The curriculum is aligned with current industry requirements and the objectives of NEP 2020.

Course Objectives:

1. Understand semiconductor materials, energy band concepts, and carrier transport mechanisms used in semiconductor devices.

2. Explain the operation and characteristics of PN junctions, MOS structures, and semiconductor devices used in VLSI systems.
3. Analyze MOSFET operation, CMOS inverter characteristics, and scaling issues in modern integrated circuits.
4. Apply semiconductor fabrication concepts and cleanroom practices used in IC manufacturing processes.
5. Examine semiconductor packaging, testing methodologies, manufacturing ecosystem, and emerging semiconductor technologies.
6. Describe VLSI design flow, EDA tools, FPGA architecture, and applications of semiconductor devices in modern electronic systems.

Course Outcomes:

After successful completion of the course the students should be able to:

1. Explain semiconductor materials, carrier transport mechanisms, and energy band concepts relevant to integrated circuit fabrication.
2. Analyze PN junctions, MOS capacitors, and MOSFET characteristics used in VLSI applications.
3. Describe semiconductor fabrication processes including oxidation, diffusion, ion implantation, photolithography, and etching techniques.
4. Analyze CMOS device operation, inverter characteristics, and scaling effects in modern integrated circuits.
5. Design basic CMOS logic circuits and evaluate their performance characteristics.
6. Interpret semiconductor manufacturing flow, cleanroom practices, packaging techniques, and emerging VLSI technologies.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Knowledge of Semiconductor Physics, Electronic Devices, Electronic Circuits, Basic Electrical & Electronics Engineering, and Fundamentals of Digital Electronics		

1	**Semiconductor Fundamentals for VLSI**	Semiconductor materials: Si, Ge, GaAs, Crystal structure and bonding, Energy band theory, Intrinsic and extrinsic semiconductors, Carrier concentration and mobility, Drift and diffusion currents, Hall effect, Fermi level concepts, Generation and recombination	08	CO1
		Self-Learning: Comparison of Si, Ge, and GaAs semiconductor materials; Crystal structure and covalent bonding in semiconductors; Energy band theory and band gap concept; Intrinsic and extrinsic semiconductors; Carrier concentration and mobility; Drift current and diffusion current; Hall effect and Fermi level concept; Generation and recombination in semiconductors.	08	
2	**PN Junction and MOS Structure**	PN junction formation and characteristics, Depletion region, Junction capacitances, Breakdown mechanisms, Metal-Semiconductor junctions, MOS capacitor structure, Accumulation, depletion, inversion, Threshold voltage, MOS electrostatics	08	CO2
		Self-Learning: PN junction formation and V-I characteristics; Depletion region and barrier potential; Junction capacitances in PN junction diode; Zener and avalanche breakdown mechanisms; Metal-semiconductor junctions and Schottky diode concept; MOS capacitor structure and operation; Accumulation, depletion, and inversion regions in MOS capacitor; Threshold voltage and MOS electrostatics.	08	

3	**MOSFET Devices and CMOS Technology**	MOSFET structure and operation, Enhancement and depletion MOSFET, I-V characteristics, CMOS technology basics, CMOS inverter operation, Noise margins, Power dissipation, Propagation delay, CMOS scaling, Short channel effects (introductory)	08	CO3
		Self-Learning: MOSFET structure and principle of operation; Enhancement and depletion type MOSFETs; I-V characteristics of MOSFET; Basics of CMOS technology; CMOS inverter operation and transfer characteristics; Noise margins and power dissipation in CMOS circuits; Propagation delay in CMOS circuits; CMOS scaling and introduction to short channel effects.	08	
4	**Semiconductor Fabrication Processes**	Silicon wafer preparation, Oxidation, Diffusion, Ion implantation, Photolithography, Etching techniques, Thin film deposition, Metallization, CMOS fabrication steps, Cleanroom concepts	07	CO4
		Self-Learning Silicon wafer preparation and basics of semiconductor manufacturing; Thermal oxidation process; Diffusion and dopant profile control; Ion implantation technique; Photolithography process in IC fabrication; Etching techniques (wet and dry etching); Thin film deposition and metallization; CMOS fabrication steps and cleanroom concepts.	07	
5	**Introduction to VLSI Manufacturing and Emerging Trends**	IC packaging basics, Testing and yield, Moore's law, FinFET basics, SOI technology, Introduction to MEMS, Semiconductor industry ecosystem, Foundries and fabless companies, Overview of FPGA and ASIC, India Semiconductor Mission overview	07	CO5

		Self-Learning: IC packaging basics and types; Testing methods and yield in semiconductor manufacturing; Moore's Law and its implications; FinFET structure and basics; Silicon-on-Insulator (SOI) technology; Introduction to MEMS (Micro-Electro-Mechanical Systems); Semiconductor industry ecosystem including foundries and fabless companies; Overview of FPGA and ASIC with introduction to India Semiconductor Mission.	07	
6	Semiconductor Design Automation and Applications	Introduction to Electronic Design Automation (EDA), VLSI Design Flow Overview, Front-End and Back-End Design Concepts, Introduction to HDL: Verilog/VHDL Overview, Basics of FPGA Architecture, Semiconductor Devices in AI, IoT and Embedded Systems, Low Power VLSI Concepts Future Trends in Semiconductor Technology	07	CO6
		Introduction to EDA tools used in semiconductor industry; Overview of VLSI design flow from specification to fabrication; Front-end and back-end design concepts; Basics of Hardware Description Languages (HDL) such as Verilog/VHDL; FPGA architecture and applications; Semiconductor devices used in AI, IoT and embedded systems; Introduction to low power VLSI concepts; Future trends in semiconductor technology.	07	
	Total		90	

Text Books

1. CMOS VLSI Design: A Circuits and Systems Perspective, Weste, Neil H. E., Harris, David, Pearson Education, 4th Edition, 2011.
2. Semiconductor Physics and Devices: Basic Principles, Neamen, Donald A., McGraw Hill Education, 4th Edition, 2012.

3. VLSI Fabrication Principles: Silicon and Gallium Arsenide, Gandhi, S. K., Wiley India, 2nd Edition, 2009.
4. Microelectronic Circuits, Sedra, Adel S., Smith, Kenneth C., Oxford University Press, 7th Edition, 2015.

Book	Best Suitable Modules
CMOS VLSI Design: A Circuits and Systems Perspective	Modules 3, 5, 6
Semiconductor Physics and Devices: Basic Principles	Modules 1, 2
VLSI Fabrication Principles: Silicon and Gallium Arsenide	Module 4
Microelectronic Circuits	Modules 2, 3

Online References:

1. **NPTEL – Semiconductor Devices and VLSI Courses (Modules 1–6)**
2. **MIT OpenCourseWare – Microelectronics and VLSI (Modules 2–6)**
3. **NanoHUB – Semiconductor and VLSI Learning Resources (Modules 2–6)**
4. **All About Circuits – Semiconductor and CMOS Tutorials (Modules 1–3)**

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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
132215702	Data Compression	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-I	IAT-II	Total					
132215702	**Data Compression**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: Data Compression is important for efficiently storing and transmitting large amounts of digital data. It reduces redundancy, saving storage space and bandwidth. The subject helps students understand and apply compression techniques for text, image, audio, and video data, making it essential for modern applications like multimedia, networking, and cloud computing.

Course Objectives:

1. Explain the fundamental principles of data compression by describing concepts such as redundancy reduction, encoding, and compression efficiency. (Understand)
2. Apply statistical compression techniques (such as Huffman coding and arithmetic coding) and dictionary-based methods (such as LZW) to solve real-world data compression problems. (Apply)
3. Demonstrate the use of image compression standards by analyzing and applying formats like JPEG, PNG, and GIF in practical scenarios. (Apply)

4. Explain video compression mechanisms by summarizing techniques such as temporal and spatial redundancy reduction used in video encoding. (Understand)
5. Describe how digital audio properties are used for compression by explaining concepts such as sampling, quantization, and perceptual coding. (Understand)
6. Expose students to modern and advanced compression standards, adaptive techniques, and practical applications in multimedia, cloud, and IoT environments.

Course Outcomes:

1. Describe the fundamental principles of data compression**(Cognitive Knowledge level: Understand)**
2. Make use of statistical and dictionary based compression techniques for various applications **(Cognitive Knowledge level: Apply)**.
3. Illustrate various image compression standards. **(Cognitive Knowledge level: Apply)**
4. Summarize video compression mechanisms to reduce the redundancy in video.**(Cognitive Knowledge level: Understand)**
5. Use the fundamental properties of digital audio to compress audio data.**(Cognitive Knowledge level: Understand)**.
6. **Analyze and apply** modern image, video, and audio compression techniques, implement real-time and adaptive compression, and use software tools for practical data compression applications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Knowledge of probability theory, computation on matrices, basic topics in data structures, storage and efficiency		
1	Modelling and types of compression	Introduction to Compression Techniques- Lossy compression & Lossless compression, Measures of Performance, Modeling and coding. Mathematical modelling for Lossless and lossy compression - Physical models and probability models.	07	CO1

		Self-Learning: Lossless and lossy compression techniques, Performance measures: compression ratio, bitrate, redundancy Basics of modeling and coding in compression, Mathematical modeling for compression, Probability models and entropy concept, Physical models in data compression	07	
2	Basic Compression Methods	Basic Compression Technique- Run length encoding, RLE Text compression. Statistical Methods- Prefix Codes, Binary Huffman coding, non-binary Huffman Algorithms, Arithmetic Coding.	08	CO2
		Self-Learning: Run Length Encoding (RLE) basics and applications; prefix codes; binary and non-binary Huffman coding; arithmetic coding; comparison of statistical compression techniques.	08	
3	Text & Image Compression	Dictionary based Coding- LZ77, LZ78 and LZW compression. Image Compression- Image standards, JPEG image Compression- Baseline JPEG, JPEG-LS.	08	CO3
		Self-Learning: Dictionary-based coding: LZ77, LZ78, and LZW techniques; basics of image compression standards; overview of JPEG compression including Baseline JPEG and JPEG-LS.	08	
4	Video Compression	Video Compression- Analog video, Digital Video, Motion Compensation. MPEG standards- MPEG 1, MPEG 4	07	CO4
		Self-Learning:	07	

		Analog and digital video basics; motion compensation techniques; overview of MPEG standards: MPEG-1 and MPEG-4.		
5	Audio Compression	Audio Compression- Basics of Digital Audio, Basic Audio Compression Techniques, MPEG Audio Compression-Layer 1 coding, Layer 2 coding and Layer 3 coding.	07	CO5
		Self-Learning: Basics of digital audio; fundamental audio compression techniques; MPEG audio compression: Layer 1, Layer 2, and Layer 3 coding.	07	
6	Advanced Topics & Applications in Data Compression	Advanced image and video compression standards (e.g., JPEG 2000, HEVC/H.265) Modern audio compression techniques (e.g., AAC, Opus) Compression for streaming and cloud applications Error-resilient and adaptive compression methods Real-time compression algorithms Use of software tools and libraries for compression (MATLAB, Python libraries, FFmpeg) Case studies of compression in multimedia, IoT, and big data	08	CO6
		Self-Learning: Modern image (JPEG 2000) and video (HEVC/H.265) compression, audio compression (AAC, Opus), adaptive/error-resilient techniques, real-time compression, cloud/IoT applications, and compression tools (MATLAB, Python, FFmpeg).	08	
	Total		90	

Text Books:

1. David Solomon, Data compression: the complete reference, 4/e, Springer, January 2007
2. Khalid Sayood, Introduction to data compression, Morgan Kaufmann Publishers,2003.

References:

1. Stephen Welstead, Fractal and wavelet Image Compression techniques, PHI, 1999.
2. Sleinreitz, Multimedia System, Addison Wesley.
3. Mark Nelson and Jean-loup Gailly, The Data Compression Book, M&T Books.

Online References:

NPTEL course: https://nptel.ac.in/courses/117104129

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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	
132215703	**Computer Networks**	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-I	IAT-II	Total					
132215703	**Computer Networks**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale:

Computer Networks is a core subject that teaches students how data is transmitted and shared across interconnected systems. It covers key concepts like network models, protocols, IP addressing, and routing. With the growing importance of the internet, cloud computing, and cybersecurity, understanding network architecture and communication is essential for careers in IT, networking, and system administration.

Course Objectives:

1 To understand the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To study the multiple layer design issues, services, and state-of-the-art protocols of TCP/IP and OSI based Architectures.
3. To help students to acquire knowledge of address in the configuration of various scales of networks.

4. To explore and evaluate protocols at various layers such as MAC protocols, IP addressing, routing algorithms, transport layer mechanisms, and application layer services.

5. To be conversant with the principles of Network Application Programming.

6. To introduce network security concepts and challenges, covering firewalls, encryption, authentication, and secure communication protocols.

Course Outcomes:

CO1: List and explain the layers of the OSI and TCP/IP models, and *describe* their respective functions.
CO2: Explain and analyze the characteristics of network devices and transmission media used in network design.
CO3*:* Explain, analyze, and evaluate Data Link Layer design issues, protocols, and medium access control mechanisms used in wired and wireless networks.
CO4: Classify and evaluate different routing protocols and *analyze* the process of IP address assignment for a given network.
CO5: Explain and analyze transport layer services, protocols (UDP/TCP), and TCP flow and congestion control mechanisms.
CO6: Explain and analyze application layer paradigms and the functioning of common network applications and services.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Computer System Basics, Programming Language (C/C++/Java)		
1	**Introduction to Data Communications and Networking**	Introduction to computer networks, Network types, Layers and services, Network topologies, protocol hierarchies, design issues for the layers. Reference models: Layer details of OSI, TCP/IP models. Communication between layers.	07	CO1
		Self-Learning: ● Case study of modern networks (data centers, cloud networks). ● Software Defined Networks (SDN). ● Real-world topology mapping (college campus, corporate network) ● Practical differences between OSI and TCP/IP models	07	

2	**Physical Layer**	Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Infrared, Circuit and Packet Switching Network Devices: Repeaters, Hubs, Switches, Routers and Gateways	07	CO2
		Self-Learning: ● Case studies on Network infrastructure in smart cities ● Data transmission in undersea fiber optic cables ● Wireless communication in mobile networks (4G/5G basics) ● Enterprise network design using switches and routers	07	
3	**Data Link Layer**	DLL Design Issues - Services, Framing, Error Control, Flow Control, Error Detection and Correction Elementary Data Link protocols, Stop and Wait, Sliding Window - Go Back N, Selective Repeat. Medium Access Control sublayer: Channel Allocation problem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD), Local Area Networks - Ethernet (802.3), Introduction to wireless LAN: 802.11x	07	CO3
		Self-Learning: ● Advanced Error Detection Techniques – CRC implementation, polynomial division, performance comparison of checksum vs CRC. ● Evolution of Ethernet Standards – From IEEE 802.3 to Gigabit and 10G Ethernet, frame structure and improvements. ● Issues in CSMA/CA and solutions like RTS/CTS.	07	

4	**Network layer**	Network Layer design issues, Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses, IPv4 Addressing (classfull and classless), Sub-netting and Super-netting design problems, IPv4 Protocol, IPv6 Packet Format, IPv6 Addressing, Transition from IPv4 to IPv6. Routing algorithms: Intra-domain Routing -Shortest Path, Distance Vector Algorithms, Link State Routing, Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters.	08	CO4
		Self-Learning: ● Communication Primitives: Unicast, Multicast, Broadcast. Congestion Control in Modern Networks – Study active queue management techniques (RED, WRED) and TCP congestion control mechanisms. Quality of Service (QoS) in Multimedia Networks – Analyze QoS models (IntServ, DiffServ), traffic shaping, and real-time application requirements.	08	
5	**Transport Layer**	The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	08	CO5
		Self-Learning: Socket Programming in Practice – Hands-on implementation using Berkeley Sockets in C/Python for client-server communication. Deep Dive into TCP 3-Way Handshake & Termination – Analyze connection setup, teardown, and security issues like SYN flooding in TCP.	08	

6	**Application layer**	Application layer Paradigms, Client-Server Paradigm: Application Programming Interface Standard Client Server applications: World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Secure Shell (SSH), Domain Name System (DNS).	08	CO6
		Self-Learning: RESTful API Design and Implementation – Learn how APIs work in the Client-Server Paradigm using HTTP methods (GET, POST, PUT, DELETE). Working of HTTP/HTTPS in Modern Web – Study request-response cycle, status codes, cookies, and security features of HTTP and HTTPS. DNS Resolution Process in Detail – Explore how DNS translates domain names to IP addresses (recursive & iterative queries).	08	
	Total		90	

Text Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education
2. Behrouz A. Forouzan, Forouzan Mosharrat, Computer Networks A Top down Approach, McGraw Hill education
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, Second Edition.

References:

1. James F. Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education.
2. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
3. W. A. Shay, Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
4. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India.

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course

Outcomes).

- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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
132215704	**Foundation of data science**	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-I	IAT-II	Total					
132215704	**Foundation of data science**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: **Foundation of Data Science** is designed to build fundamental knowledge and practical skills required to analyze, interpret, and extract meaningful insights from data. In today's digital era, data is generated continuously from social media, business transactions, sensors, healthcare systems, and scientific research. Understanding how to manage and analyze this data is essential for informed decision-making. For Electronics and Computer Science Engineering (ECS) students, Foundation of Data Science is highly important because it connects core engineering concepts with intelligent data-driven systems.

Course Objectives:

1. To understand data-intensive problem solving approaches and apply systematic analytical thinking to real-world engineering problems.
2. To learn and implement data collection, data preprocessing, data visualization, and data modeling techniques using appropriate tools and technologies.
3. To apply statistical methods and computer science techniques for analyzing, interpreting, and extracting meaningful insights from data.
4. To develop the ability to design and build basic data-driven solutions for practical applications in Electronics and Computer Science domains.
5. To prepare students for industry roles in Data Science, Artificial Intelligence, Machine Learning, and Analytics by building strong foundational knowledge and practical skills.
6. To explore parallel processing architectures including multicore and multiprocessor systems.

Course Outcomes:

1. To perform Exploratory Data Analysis (EDA) to summarize dataset characteristics and identify patterns and relationships.
2. To collect, clean, and transform datasets to prepare structured data for analysis.
3. To detect and handle missing values, outliers, and data inconsistencies using appropriate preprocessing techniques.
4. To apply statistical analysis methods to interpret data and support decision-making.
5. To create meaningful data visualizations using suitable tools for effective presentation of insights.
6. To analyze real-world datasets and communicate actionable insights based on data-driven findings.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic Programming Concepts Mathematics and Statistics Database Management Systems		
1	Introduction to Data Science	**1.1** Introduction to Data Science **1.2** Data Science Lifecycle **1.3** Data Science Process and Workflow **1.4** Data Mining and Data Warehousing Concepts **1.5** Applications of Data Science in Engineering Domains **1.6** Types of Data and Data Sources **1.7** Role of Data Science in AI and Machine Learning	08	CO1

		Self-Learning: Comparison between Data Science, Data Analytics and Business Intelligence Case Study: Data Science in Smart City Applications Overview of popular Data Science tools (Python, R, Tableau)	08	
2	Describing Data	2.1 Types of Data and Variables 2.2 Tables and Graphical Representation of Data 2.3 Measures of Central Tendency (Mean, Median, Mode) 2.4 Measures of Dispersion (Range, Variance, Standard Deviation) 2.5 Skewness and Kurtosis 2.6 Normal Distribution and Z-Score	07	CO2
		Self-Learning: Real-world dataset visualization using Python Box Plot and Histogram Interpretation Case Study: Student Performance Data Analysis	07	
3	Describing Relationships	3.1 Correlation Analysis 3.2 Scatter Plots and Relationship Visualization 3.3 Simple Linear Regression 3.4 Least Square Regression Line 3.5 Multiple Regression and Interpretation 3.6 Coefficient of Determination (R^2)	07	CO3
		Self-Learning: Correlation vs Causation Regression using Python libraries Case Study: Sales Prediction Analysis	07	
4	Exploratory Data Analysis (EDA)	4.1 Introduction to Exploratory Data Analysis 4.2 Data Visualization Techniques 4.3 Hypothesis Testing 4.4 Statistical Inference 4.5 Confidence Intervals 4.6 Data Interpretation and Insight Generation	08	CO4

		Self-Learning: Visualization tools overview (Matplotlib, Seaborn, Power BI) A/B Testing Basics Case Study: Healthcare Data Analysis	08	
5	Parallel processing	5.1 Data Cleaning Techniques 5.2 Handling Missing Values and Outliers 5.3 Data Transformation and Normalization 5.4 Feature Selection Techniques 5.5 Dimensionality Reduction (PCA and SVD Basics) 5.6 Introduction to Predictive Modeling	07	CO5
		Self-Learning: Feature Engineering Concepts Model Validation Techniques Case Study: Credit Risk Analysis	07	
6	Advanced Data Analytics and Applications	6.1 Introduction to Machine Learning Concepts 6.2 Supervised vs Unsupervised Learning 6.3 Model Evaluation Techniques (Accuracy, Precision, Recall, F1-Score) 6.4 Cross Validation Techniques 6.5 Introduction to Time Series Analysis 6.6 Basics of Big Data Analytics 6.7 Ethical Issues and Data Privacy in Data Science 6.8 Real-world Applications of Data Science in Engineering	08	CO6
		Self-Learning: Introduction to Deep Learning Cloud-based Data Science Platforms Case Study: Predictive Maintenance using IoT Data Case Study: Fraud Detection System	08	
	Total		90	

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.
2. Sam Anahory & Dennis Murray, "Data Warehousing in the Real World", Pearson.

References:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson.
2. Ralph Kimball & Margy Ross, "The Data Warehouse Toolkit", Wiley.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron .

Online References:

1. **NPTEL – Data Warehousing and Data Mining (IIT Kharagpur / IIT Delhi)** https://onlinecourses.nptel.ac.in
2. **IBM Knowledge Center – Data Warehousing & Data Mining Concepts** https://www.ibm.com/docs
3. **Coursera – Machine Learning & Data Mining Courses** https://www.coursera.org
4. **Analytics Vidhya – Tutorials on ETL, Classification, Clustering & Association Rules** https://www.analyticsvidhya.com

Summary of Internal Assessment (IA) and End Semester Examination (ESE)

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of 20 marks each will be conducted.
- IAT-I will cover three CO's and IAT-II will cover the remaining three CO's (Course Outcomes).
- Duration of each test: 1 hour.
- The summation of both tests will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: 2 Hours 30 Minutes
- Question paper consists of six compulsory questions, 10 marks each.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have two alternatives (Option A / Option B) from the same module.
- Both options should be of similar difficulty level and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the entire syllabus, all Course Outcomes, and different levels of learning as per Bloom's Taxonomy.

Note: -

1. Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks
2. No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.

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	
13412509	**Linux Lab**	--	--	2	--	--	30	--	30	**1**

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13412509	**Linux Lab**	--	--	--	--	--	25		**25**

Lab Objectives:

1. To Install and configure the Linux operating system.
2. To Execute general purpose commands of the Linux operating system.
3. To Manage files and directories in Linux operating system.
4. To Use vi editor in Linux operating system.
5. To Execute filters commands in Linux
6. To Write programs using shell script.

Lab Outcomes:

After the successful completion students should be able to

1. Understand the basics of Linux operating system fundamentals and its open-source nature. (LO1)
2. Execute general purpose commands of the Linux operating system (LO2)
3. Ability to perform file operations and manipulate directories (LO3)
4. Use vi editor and execute all editor commands. (LO4)
5. Execute filters commands in Linux (LO5)
6. Write programs using shell script. (LO6)

DETAILED SYLLABUS

Sr. No.	Experiment Title	Description	LO Mapping
1	Install the Linux operating system.	Install and configure the Linux operating system.	LO1
2	Execute general-purpose Linux commands.	Execute general purpose commands cal, date, echo, printf, bc, script, mailx, man, clear	LO2
3	Execute the following general-purpose Linux commands.	Execute general purpose commands 1)passwd 2)who 3)whoami 4)uname 5)tty 6)stty 7)ps 8)kill 9) sleep	LO2
4	Execute the following file and Directory manipulation commands	Execute the following file and Directory manipulation commands along with different options.1.)pwd 2)cd 3)mkdir 4)rmdir 5)ls 6)cat 7)rm 8)mv 9)cp	LO3
5	File and Directory manipulation commands	Execute the following file and Directory manipulation commands along with different options.1) touch 2)more 3)lp 4)file 5)wc 6)cmp 7)comm 8)diff 9)split	LO3
6	Linux commands for compressing decompressing and archiving files.	Execute Linux commands for compressing, decompressing, and archiving files.	LO3
7	File and directory permissions.	Execute the commands to change file and directory permissions.	LO3
8	vi editor to create and edit files	TO Use vi editor to create and edit file	LO4
9	Use wildcard characters	Use wildcard characters (e.g., *, ?, []) to list and manipulate specific sets of files within the directory.	LO4
10	Use of Pipes in Linux.	a) Create a text file with various lines of text. b) Create a complex pipeline by chaining multiple commands together using pipes (|).	LO4
11	input and output redirection in Linux.	Create input and output redirection in Linux.	LO4
12	Execute the filters commands in Linux.	Execute the following filters command in Linux 1)pr 2)head 3) tail 4) cut 5) paste 6) sort 7)uniq 8)tr	LO5

13	Execute filters commands in Linux.	Execute commands grep, egrep and sed in Linux	LO5
14	Execute the Shell scripts.	Read user input, exit and exit status commands, expr, and logical operators in shell scripts.	LO6
15	Execute the Shell script by using the if statement.	Write the shell script by using the "if" statement	LO6
16	Execute a Shell script by using the while loop	Write the shell script by using the "while" statement	LO6
17	Execute a Shell script by using the for loop	Write the shell script by using the "for" statement	LO6

Text Books:

1. Linux: The Complete Reference, Sixth Edition by Richard Petersen, McGraw Hill Education; 6th edition (1 July 2017).
2. Linux Command Line and Shell Scripting Bible by Richard Blum Wiley; 3rd edition (17 March 2015).
3. Red hat Linux Networking and System Administration, by Terry Collings and Kurt Wall, Wiley 3rd edition 2005

References:

1. Linux Administration: A Beginner's Guide by Wale Soyinka, McGraw-Hill Education; 8th edition (28 April 2020).
2. Red Hat Enterprise Linux 6 Administration, Real World Skills for Red Hat Administrators by Sander van Vugt, John Wiley and Sons 2013.
3. Rhcsa Red Hat Enterprise Linux 8: Training and Exam Preparation Guide, Asghar Ghori, Endeavor Technologies (10 January 2020).

Online Resources:

Sr. No.	Website Name
1.	http://www.ee.surrey.ac.uk/Teaching/Unix/
2.	https://www.cs.sfu.ca/~ggbaker/reference/unix/

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)

SEM VI

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	
13211601	Artificial Intelligence and Machine Learning	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)		
		IAT-I	IAT-II	Total				
13211601	Artificial Intelligence and Machine Learning	20	20	40	60	2.5	--	100

Rationale: Artificial Intelligence and Machine Learning enable systems to learn from data, make decisions, and automate intelligent tasks. This course provides theoretical and practical knowledge required to design intelligent systems used in real-world applications.

Course Objectives:

1. To introduce fundamental concepts of Artificial Intelligence and intelligent agents.
2. To understand problem-solving techniques using search algorithms.
3. To develop knowledge representation and logical reasoning skills.
4. To understand fundamental concepts of Machine Learning, data preprocessing, and performance evaluation techniques.
5. To apply mathematical foundations and core machine learning models.
6. To analyze and implement neural networks and advanced techniques.

Course Outcomes:

1. Explain AI concepts and analyze different types of intelligent agents.
2. Apply appropriate search techniques to solve real-world problems.
3. Represent knowledge using logic and perform inference.

4. Explain key Machine Learning concepts and evaluate models using standard performance metrics.
5. Apply linear algebra concepts and implement basic machine learning models for prediction and classification tasks.
6. Design and analyze neural network models and apply techniques.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic knowledge of programming Understanding of data structures Fundamentals of discrete mathematics (logic, sets, relations)		
1	**Introduction to AI and Intelligent Agents**	Definition, scope, and history of Artificial Intelligence (AI): definition and goals of AI, scope of AI in modern computing and engineering, evolution of AI, and applications of AI in engineering. Intelligent agents and environments: definition of an intelligent agent, components of an agent, concept of rationality, types of agents: simple reflex, model-based, goal-based, and utility-based agents; Agent environment types; types of AI: weak AI and strong AI.	07	CO1
		Self-Learning: History and evolution of AI Case studies of AI applications (healthcare, finance) Comparison of AI, ML, and Deep Learning	07	
2	**Problem Solving using Search Techniques**	State space representation: concept of problem solving in AI, definition of state space, representation using state space trees and graphs, examples: 8-puzzle and route finding. Performance measures of search algorithms: completeness, optimality, time complexity and space complexity Uninformed search techniques: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search (DLS), Iterative Deepening Search (IDS).	08	CO2

		Informed search techniques: Greedy Best First Search, A* algorithm, heuristic functions, and admissibility. Local search techniques: hill climbing Genetic Algorithm Game playing: minimax algorithm and alpha-beta pruning.		
		Self-Learning: Implementation of A* for pathfinding Comparison of search algorithms Real-world applications (navigation systems, games)	08	
3	Knowledge Representation and Logical Reasoning	Knowledge representation schemes, propositional logic (PL): basics of logic and statements, syntax and semantics, logical connectives, truth tables, conversion to conjunctive normal form (CNF). First-Order Predicate Logic (FOPL): syntax and semantics, predicates, constants, variables, functions, and quantifiers; representation of real-world knowledge. Inference rules in FOPL, inference techniques: forward chaining, backward chaining, and resolution in FOPL.	08	CO3
		Self-Learning: Solving real problems using resolution Basics of PROLOG programming Knowledge-based systems in AI	08	
4	ML Fundamentals & Evaluation	Introduction to Machine Learning: types of learning: supervised and unsupervised learning, classification, clustering, prediction and regression Training, testing, and validation datasets; overfitting and under fitting; cross-validation; and performance measures: confusion matrix, accuracy, precision, recall, and F1-score.	08	CO4
		Self-Learning: Real-world Applications of Machine Learning Data Preprocessing Techniques Cross-Validation Techniques Ethical Issues in Machine Learning	08	

5	Mathematical Foundations & Core Models	Eigenvalues and Eigenvectors Linear Models: Linear Regression (Least Squares), Logistic Regression, Support Vector Machines (SVM)	07	CO5
		Self-Learning: SVD application Regularization Techniques Assumptions of Linear Regression	07	
6	Neural Networks & Advanced Techniques	Neural Networks: McCulloch-Pitts Model, Perceptron Model (with bias), Activation Functions (Binary, Bipolar, Ramp, Sigmoid, etc.) Advanced Topics: Curse of Dimensionality, Dimensionality reduction techniques, Principal Component Analysis (PCA)	07	CO6
		Self-Learning: Challenges in Training Neural Networks Practical Implementation of Neural Networks K-Means Clustering (Detailed Study)	07	
	Total		90	

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach,Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight ―Artificial Intelligence, Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. George F Luger “Artificial Intelligence” Low Price Edition, Pearson Education., Fourth edition.
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow for practical coding by Aurelian Géron, Practical ML book with implementation and real-world examples.
5. Neural Networks: A Comprehensive Foundation by simon Haykin.

References:

- Saroj Kaushik “Artificial Intelligence”, Cengage Learning.
- Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville
  (Comprehensive deep learning reference, widely considered foundational)
- Machine Learning for Absolute Beginners: A Plain English Introduction Book by Oliver. Theobald.
- N. P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press.

Online References:

1. NPTEL – Artificial Intelligence by Prof. Deepak Khemani (IIT Madras) https://nptel.ac.in/courses/106106126.
2. NPTEL – Introduction to Machine Learning by Prof. Balaraman Ravindran (IIT Madras) https://nptel.ac.in/courses/106106139
3. Coursera – Machine Learning by Andrew Ng (Stanford University) https://www.coursera.org/learn/machine-learning
4. Google Machine Learning Crash Course https://developers.google.com/machine-learning/crash-course
5. Scikit-learn Documentation (Machine Learning Library) https://scikit-learn.org/stable/
6. Kaggle – Datasets and Practice for Machine Learning https://www.kaggle.com/

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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	
13211602	Software Engineering	3		--	45	-	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211602	Software Engineering	20	20	40	60	2.5	--	--	100

Rationale: Software Engineering provides a structured approach to software development, covering key areas like requirements, design, testing, and project management. It helps students build reliable, maintainable, and scalable software systems using industry-standard practices. This subject prepares students to handle real-world projects efficiently while ensuring quality, collaboration, and innovation in software development.

Course Objectives:

1. To learn the basics of software engineering and software development process models including agile practices.
2. To identify, specify and analyze software requirements and prepare requirement models.
3. To understand concepts and principles of software design and development.
4. To learn project scheduling concepts and software cost estimation techniques.
5. To understand software quality assurance and risk management.
6. To learn various software testing strategies and techniques.

Course Outcomes:

CO1: Apply software engineering concepts and select appropriate process models for software development.
CO2: Analyze and prepare Software Requirement Specification (SRS).
CO3: Transform requirement models into design models and apply UI design principles.
CO4: Prepare project schedules and estimate software development cost.

CO5: Identify risks and prepare risk mitigation plans for software projects.
CO6: Apply software testing strategies and testing techniques.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Knowledge of software application domains. knowledge of basic programming languages and software development practices.		
1	**Introduction to Software Engineering and Process Models**	1.1 Nature of Software, Software Process framework. 1.2 Prescriptive Models: Waterfall Model, Incremental, RAD Models Evolutionary Process Models: Prototyping, Spiral and Concurrent Development Model. Specialized Models: Component based 1.3 Agile process, Agility Principles, Extreme Programming (XP), Scrum.	07	CO1
		Self-Learning: Characteristics of Good Software Comparison of Software Process Models. Real-World Applications of Agile Methodology Agile vs Traditional Development Tools Used in Agile Development	07	
2	**Requirement Engineering and Modelling**	2.1 Types of Requirements, Requirement Engineering Task, Software Requirement Specification (SRS), Developing Use Cases (UML). 2.2 Requirement Model: Scenario-based model, Class-based model, Behavioral model.	07	CO2
		Self-Learning: Case study for SRS document for given problem statement. Develop Usecase diagram for given problem statement. Develop activity diagram for given problem statement Develop sequence diagram for given problem statement.	07	

3	**Design Engineering**	3.1Design Concepts, Characteristics of Good Design, Effective Modular Design – Cohesion and Coupling. 3.2 Architectural Styles, User Interface Design: Principles of UI Design, User Experience (UX) Considerations, Component-Level Design and Reuse	07	CO3
		Self-Learning: Design quality Introduction to Pattern-Based Software Design Software Architecture, Data Design User Interface Design: Rules, User Interface Analysis Software Reuse, Component-Based Software Engineering	07	
4	**Project scheduling & Cost Estimation**	4.1 Project Scheduling, defining a Task Set for the Software Project, Gantt charts, Program Evaluation Review Techniques (PERT), Tracking the Schedule. 4.2 Software Project Estimation, Decomposition Techniques, LOC based, FP based and Use case-based estimations, Empirical estimation Models. COCOMO II Model.	08	CO4
		Self-Learning: Prepare Gantt chart on any tool. Solve numerical on PERT formula Numerical based on COCOMO model.	08	
5	**Software Risk & Quality Management**	5.1 Software Risk, Types of Risk, Risk Identification, Risk Assessment, Risk Projection, RMMM. 5.2 Software Quality Assurance Task and Plan, McCall's Quality Factors, Software Reliability, Formal Technical Review (FTR), Walkthrough	08	CO5

		Self-Learning: Risk Management Process in Software Engineering Risk Breakdown Structure (RBS) Tools used for Risk Management (Risk Register, Risk Matrix) Static vs Dynamic Quality Assurance Methods Code Inspection and Peer Review Process	08	
6	**Software Testing Strategies and Tactics**	6.1Software Testing Fundamentals, Testing strategies for conventional and Object Oriented architectures, Unit testing, Integration testing, System Testing, Validation and System Testing. 6.2 Testing Tactics: White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.	08	CO6
		Self-Learning: Test Case Design. Test Plan and Test Strategy Preparation Review of OOA and OOD models, Code Coverage Metrics Static Testing vs Dynamic Testing – comparison and use cases. Introduction to Testing Tools	08	
		comparison and use cases. Introduction to Testing Tools	08	
	Total		90	

Text Books:

1. Roger S Pressman “Software Engineering: A Practitioner’s Approach” 8th Edition McGraw- Hill, ISBN:978-0-07-802212-8

2. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa

References:

1. Ian Sommerville, “Software Engineering”, Pearson Education (9th edition)

2. Jibitesh Mishra and Ashok Mohanty, “Software Engineering”, Pearson edition

3. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India

4. Hans Van Vilet, “Software Engineering Principles and Practice” 3rd edition Wiley

Online References:

NPTEL course: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs151

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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	
13211603	**Data Warehousing and Data Mining**	3	--	--	45	-	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211603	**Data Warehousing and Data Mining**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: Data Warehousing and Data Mining are essential technologies for decision support systems and business intelligence. Data warehousing provides structured storage and multidimensional modeling of large volumes of data, while data mining extracts meaningful patterns, trends, and knowledge from datasets.

For Electronics and Computer Science Engineering students, this subject builds analytical thinking and provides foundations for Artificial Intelligence, Machine Learning, Big Data Analytics, and Business Intelligence systems.

Course Objectives:

1. To **explain** architecture, characteristics, and schema models of data warehousing and differentiate OLTP and OLAP systems.
2. To **design** and implement ETL processes and apply OLAP operations for multidimensional analysis.
3. To **apply** data preprocessing techniques to prepare datasets for mining.
4. To **implement** association rule mining techniques such as Apriori and FP-Growth.
5. To **develop** classification and prediction models using Decision Trees, Logistic Regression, and Bayesian techniques.

6. To **apply** clustering algorithms such as K-Means and Hierarchical clustering for similarity-based grouping.

Course Outcomes:

1. **Explain** data warehouse architecture and dimensional modeling concepts.
2. **Design** ETL processes and perform OLAP operations.
3. **Apply** data preprocessing techniques for mining.
4. **Implement** frequent pattern mining and association rule techniques**.**
5. **Develop** classification and prediction models.
6. **Apply** clustering techniques and analyze real-world datasets.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Database Management Systems, Probability & Statistics, Basic Programming Concepts		
1	Introductory Concepts	1.1 Vision, Mission, CO and Syllabus Discussion 1.2 Introduction to Data Warehouse 1.3 Characteristics of Data Warehouse 1.4 Components of Data Warehouse Architecture 1.5 Data Marts and Data Warehouses vs Data Marts 1.6 E-R Modelling vs Dimensional Modelling 1.7 Data Warehouse Schemas: Star Schema, Snowflake Schema 1.8 Fact-less Fact Table, Fact Constellation Schema 1.9 Inside Dimension Table and Fact Table 1.10 Updating Dimension Tables 1.11 OLTP Systems vs OLAP Systems	08	CO1
		Self-Learning: Comparison of Enterprise Data Warehouse vs Data Lake Slowly Changing Dimensions (SCD Types 1,2,3) Real-world OLAP tools overview Case Study: Retail Sales Data Warehouse Implementation	08	
2	Processor Organization	2.1 Major Steps in ETL Process 2.2 Data Extraction Methods 2.3 Data Transformation: Basic Tasks and Major Types 2.4 Data Loading Techniques 2.5 Multidimensional Data Model 2.6 OLAP Models: MOLAP, ROLAP	06	CO2

		2.7 OLAP Operations: Slice, Dice, Roll-up, Drill-down, Pivot		
		Self-Learning: ETL tools (Informatica, Talend) Data Cube computation techniques Case Study: Banking Loan Analysis System	06	
3	Memory Organization	3.1 Introduction to Data Mining 3.2 Data Mining Architecture 3.3 KDD Process 3.4 Data Mining Functionalities 3.5 Interestingness Measures 3.6 Classification of Data Mining Systems 3.7 Major Issues in Data Mining 3.8 Data Cleaning, Integration, Transformation 3.9 Data Reduction 3.10 Data Discretization and Concept Hierarchy	07	CO3
		Self-Learning: Real-world preprocessing using Python libraries Data quality assessment techniques Type of attributes Case Study: Healthcare Patient Data Cleaning	07	
4	I/O Organization	4.1 Market Basket Analysis 4.2 Frequent Itemsets 4.3 Closed Itemsets and Association Rules 4.4 Frequent Pattern Mining 4.5 Apriori Algorithm 4.6 Association Rule Generation 4.7 FP-Growth Algorithm	08	CO4
		Self-Learning: Comparison: Apriori vs FP-Growth Applications in Retail and E-commerce Case Study: Supermarket Market Basket Analysis	08	
5	Parallel processing	5.1 Introduction to Classification 5.2 Decision Tree Induction 5.3 Bayesian Classification 5.4 Introduction to Prediction 5.5 Linear Regression 5.6 Logistic Regression 5.7 Accuracy and Error Measures	07	CO5
		Self-Learning: Confusion Matrix and ROC Curve Overfitting and Model Validation Case Study: Credit Card Fraud Detection	07	

6	Enhancements of Advanced Processor Architectures	6.1 Introduction to Clustering 6.2 Distance Measures 6.3 Partitioning Algorithms: K-Means, K-Medoids 6.4 Hierarchical Clustering 6.5 Agglomerative and Divisive Clustering 6.6 Role of Data Mining in Artificial Intelligence 6.7 Applications and Trends in Data Mining	09	CO6
		Self-Learning: DBSCAN algorithm overview Clustering evaluation metrics Case Study: Telecom Customer Segmentation	09	
	Total		90	

Text Books:

1. Urvashi Sharma, Sonali padalkar & Khushbu Tikhe, " Datawarehousing and Data Mining: Concept, Models and Applications" Guru Shishya Publication.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.
3. Sam Anahory & Dennis Murray, "Data Warehousing in the Real World", Pearson.

References:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson.
2. Ralph Kimball & Margy Ross, "The Data Warehouse Toolkit", Wiley.

Online References:

1. NPTEL – Data Warehousing and Data Mining (IIT Kharagpur / IIT Delhi) https://onlinecourses.nptel.ac.in
2. IBM Knowledge Center – Data Warehousing & Data Mining Concepts https://www.ibm.com/docs
3. Coursera – Machine Learning & Data Mining Courses https://www.coursera.org
4. Analytics Vidhya – Tutorials on ETL, Classification, Clustering & Association Rules https://www.analyticsvidhya.com

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.

- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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	
13212604	AIML Lab	-	-	2	-	-	30		30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13212604	AIML Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To develop Python programming skills and design intelligent agents for AI applications.
2. To implement and analyze AI search algorithms for problem-solving and optimization.
3. To represent knowledge and perform logical reasoning using PROLOG and logic-based techniques. .
4. To apply machine learning methods for data analysis, clustering, and performance evaluation.
5. TTo develop and evaluate predictive models using supervised learning algorithms. .
6. To implement neural network fundamentals and dimensionality reduction techniques for intelligent decision-making.

Lab Outcomes:

After the successful completion students should be able to

1. Implement basic AI programs using Python. (LO1)
2. Apply search algorithms for problem-solving. (LO2)
3. Represent knowledge and perform logical inference. (LO3)

4. Apply machine learning concepts, data validation techniques, and performance metrics to evaluate models. (LO4)
5. Apply eigenvalues/eigenvectors and linear models (Linear Regression, Logistic Regression, SVM) for data analysis and prediction.
6. Implement neural network models and dimensionality reduction techniques. (LO6)

DETAILED SYLLABUS

Sr. No.	Experiment Title	Description	LO Mapping
1	Python Basics for AI	Introduction to Python, NumPy, Pandas	LO1
2	PEAS Description & Agent Design	Define PEAS and identify agent types for real-world problems	LO1
3	Introduction to PROLOG	Write basic PROLOG programs using facts and simple queries to understand syntax and execution.	LO3
4	Family Tree using PROLOG	Implement family relationships using facts and rules to perform logical inference.	LO3
5	Implementation of BFS,DFS	Solve problem using Breadth First Search and depth first search	LO2
6	A* Search Algorithm	Implement A* for pathfinding / 8-puzzle	LO2
7	Hill Climbing Algorithm	Solve optimization problem using local search	LO2
9	Propositional Logic Implementation	Truth table generation and logical evaluation	LO3
8	Predicate Logic & Inference	Forward/Backward chaining implementation	LO3
09	Resolution Method	Prove statements using resolution	LO3
10	Unsupervised Learning – Clustering	To group data using clustering techniques.	LO4
11	Confusion Matrix Implementation	To evaluate classification results using confusion matrix.	LO4
12	Linear Regression	To implement simple linear regression using least squares method (Scikit-learn)	LO5
13	Logistic Regression	Binary classification	LO5
14	Eigenvalues and Eigenvectors using Python	To compute eigenvalues and eigenvectors of a given matrix.	LO5
15	Support VectorMachine (SVM) – Linear Kernel	To implement SVM with linear kernel.	LO5
16	PCA & Model Evaluation	Dimensionality reduction + evaluation metrics	LO6
17	McCulloch-Pitts Neuron Model	To implement McCulloch-Pitts neuron for logical operations.	LO6

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight ―Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow for practical coding by Aurelian Géron, Practical ML book with implementation and real-world examples

References Book:

1. Ivan Bratko “PROLOG Programming for Artificial Intelligence”, Pearson Education, Third Edition.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3. Saroj Kaushik “Artificial Intelligence”, Cengage Learning.
4. Davis E. Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
5. Patrick HenryWinston, “Artificial Intelligence”, Addison-Wesley, Third Edition.
6. N. P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press.

Online Resources:

Sr. No.	Website Name
1.	**Virtual Lab1 :** https://ai1-iiith.vlabs.ac.in/
2.	**Virtual Lab2 :** https://ai1-iiith.vlabs.ac.in/
3.	**https://cse22-iiith.vlabs.ac.in/**
4	**https://ml-iitr.vlabs.ac.in/**

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)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
13212605	DWM & Software Engineering Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13212605	DWM & Software Engineering Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand data warehousing schemas and design a warehouse using dimensional modelling.
2. To implement ETL operations and OLAP functionalities for decision-making systems.
3. To perform data preprocessing operations on real-world datasets.
4. To apply association rule mining for pattern discovery.
5. To implement classification and prediction models on urban data.
6. To analyze real-world data using clustering techniques for resource planning and decision support.
7. Discuss and Analyse how to develop software requirements specifications for a given problem.
8. To implement various software designs, data flow diagram models.

Lab Outcomes:

1. Design and implement data warehouse schemas using dimensional modeling techniques, along with ETL processes for data integration.
2. Apply OLAP operations to perform efficient multidimensional data analysis.

3. Preprocess and analyze datasets using standard data cleaning methods and association rule mining to discover meaningful patterns.
4. Develop data mining models by implementing classification, prediction, and clustering techniques for knowledge extraction from datasets.
5. Ability to identify the minimum requirements for the development of application.
6. Understand and develop various UML diagrams.

DETAILED SYLLABUS

Sr. No	List of Experiment	Hours	LO Mapping
1.	Design dimensional models (star and snowflake schema)	2	LO1
2.	Implement dimension tables and fact tables	2	LO1
3.	Simulate ETL process (extract, clean, load) using Python.	2	LO1
4.	Perform Data Pre-processing tasks and demonstrate Classification, clustering, and association algorithms on data sets using data mining tool Using WEKA Tool	2	LO2
5.	Apply data integration and transformation on environmental dataset	2	LO2
6.	KDD Process Implementation on a healthcare dataset using Python	2	LO2
7.	Implement Apriori algorithm to find frequent itemsets using WEKA Tool	2	LO3
8.	Perform FP-Growth algorithm for pattern mining Using WEKA Tool	2	LO3
9.	Build and evaluate a Decision Tree classifier and Naïve Bayes classifier Using WEKA Tool	2	LO4
10.	Implementation and Analysis of K-Means clustering and Agglomerative Hierarchical Clustering Using WEKA Tool	2	LO4
11	Identify suitable process models for the problem statement .	2	LO5
12	Develop Software Requirement Specification (SRS) document in IEEE format for the project.	2	LO5
13	Identify scenarios & develop UML Use case Diagram for the project.	2	LO6
14	Develop an activity / State Transition diagram and sequence.	2	LO6

	diagram for the project.		
15	Study of any testing tool (e.g. Selenium).	2	LO6

Text Books:

1. **Paulraj Ponniah**, *"Data Warehousing: Fundamentals for IT Professionals"*, Wiley India.
2. **Jiawei Han, Micheline Kamber, Jian Pei**, *"Data Mining: Concepts and Techniques"*, Morgan Kaufmann.
3. **Pang-Ning Tan, Michael Steinbach, Vipin Kumar**, *"Introduction to Data Mining"*, Pearson Education.
4. **Roger S Pressman** "Software Engineering: A Practitioner's Approach" 8th Edition McGraw-Hill, ISBN:978-0-07-802212-8.

References Book:

1. **William H. Inmon**, *"Building the Data Warehouse"*, Wiley India.
2. **Ralph Kimball**, *"The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling"*, Wiley India.
3. **Max Bramer**, *"Principles of Data Mining"*, Springer.
4. **Manaranjan Pradhan, U. Dinesh Kumar**, *"Machine Learning Using Python"*, Wiley.
5. **Joel Grus**, *"Data Science from Scratch: First Principles with Python"*, O'Reilly Media.
6. **Rajib Mall,** "Fundamentals of Software Engineering", Prentice Hall India.

Online Resources:

Sr. No.	Website Name
1.	**WEKA Tool and Documentation** – https://www.cs.waikato.ac.nz/ml/weka/
2.	**Scikit-learn (sklearn) Library** – https://scikit-learn.org/stable/
3. .	DataCamp – Interactive Python and R Coding – https://www.datacamp.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)					Total Credits (C) (Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
13812606	Dissertation-I	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13812606	Dissertation-I	-	-	-	-	-	50	50	100

Course Objectives

1. To enable students to explore the wide range of topics, give an opportunity for innovation, search for the professional literature and apply the problem-solving approaches.
2. To help students in problem formulation, setting project goals and utilization of the available resources in an optimum manner leading to innovation.
3. To develop managerial skills in students while working in a team, creative skills by demonstrating novel engineering solutions, communication skills while presenting their end application and an awareness of social and ethical ramifications of their work.
4. To teach writing a technical document and help students to represent the professional literature.

Course Outcome: Learner will be able to:

1. Ability to acquire the thinking pattern which explores a wide range of topics for innovation.
2. Ability to learn the technique of analysis, classification and then selection of appropriate literature.
3. Ability to learn to formulate a worthwhile problem statement and the methodology to apply the problem-solving approaches.
4. Ability to learn to communicate effectively with others to discuss technical, social needs and find an engineering solution. At the same time, imbibing the virtue of team-spirit.

5. Ability to develop skills for writing a technical document.
6. Ability to practice to maintain and prepare a Project Report/ Synopsis Report of the work done as evidence of an ability to work independently and in a group for the given task.

Guidelines for Dissertation

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.

2. Students should do survey and identify needs, which shall be converted into problem statements for project in consultation with faculty supervisor/head of department/internal committee of faculties.

3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of Dissertation -I.

4. A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.

5. Faculty supervisors may give inputs to students during Dissertation -1 & II activity; however, focus shall be on self-learning.

6. Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor.

7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.

8. The solution to be validated with proper justification and report to be compiled in standard format of institute.

9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Dissertation, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Dissertation -1 in semester VI and Dissertation –II in semesters VII.

10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Dissertation adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to Scopus paper publications in Journal/Conference or Copyright or Patent as an extension of the Dissertation -1 with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on a case by case basis.

Guidelines for Assessment of Dissertation:

Term Work

1. The review/ progress monitoring committee shall be constituted by the Head of department of each institute. The progress of Dissertation -1 to be evaluated on a continuous basis, minimum two reviews in each semester VI and VII.
2. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
3. Distribution of Term work marks for both semesters shall be as below;

a. Marks awarded by guide/supervisor based on log book : 10
b. Marks awarded by review committee 10
c. Quality of Project report 05

Review/progress monitoring committee may consider following points for assessment based on either one-year major project as mentioned in general guidelines.

One-year project:

- In semester VI entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype. Two reviews will be conducted based on presentation given by students group.
- First shall be for finalization of problem and proposed solution of the problem
- Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
- First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.
- Second review shall be based on paper presentation in conference/journal or motivate for copyright or Indian patent in last month of the said semester.

Assessment criteria of Dissertation -1.

Dissertation -1 shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual as member or leader
13. Clarity in written and oral communication

In **one year, project**, first semester evaluation may be based on the first six criteria and the remaining may be used for second semester evaluation of performance of student's project.

Guidelines for Assessment of Dissertation Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Project shall be assessed through a presentation and demonstration of the working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by Head of Institution.

- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Dissertation -1 shall be assessed based on following points;

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

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	
132216701	**ASIC Verification**	**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-I	IAT-II	Total					
132216701	**ASIC Verification**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: Application-Specific Integrated Circuits (ASICs) are custom-designed integrated circuits optimized for specific applications. They provide better performance, lower power consumption, and reduced area compared to general-purpose ICs. ASIC design is fundamental in modern electronics such as smartphones, IoT devices, automotive systems, and AI hardware. This course introduces students to ASIC design flow, HDL modeling, synthesis, physical design, and testing.

Course Objectives:

1. Understand ASIC design flow and methodologies.
2. Learn HDL (Verilog/VHDL) for digital design.
3. Apply logic synthesis and optimization techniques.
4. Understand physical design and layout concepts.
5. Study testing and verification methods.
6. Explore real-world ASIC applications.

Course Outcomes:

After successful completion of the course students will be able to:

CO1: Explain ASIC design flow and architecture.
CO2: Design digital systems using HDL.
CO3: Apply synthesis and optimization techniques.
CO4: Analyze physical design and layout processes.
CO5: Evaluate testing and verification methods.
CO6: Apply ASIC concepts to real-world systems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	• Digital Electronics • CMOS Fundamentals • Basics of VLSI Design		
1	Introduction to ASIC Design	1.1 VLSI and ASIC overview 1.2 Types of ASICs: Full custom, Semi-custom, Gate array, FPGA 1.3 ASIC vs FPGA vs SoC 1.4 ASIC Design Flow 1.5 Applications of ASICs	07	CO1
		Self-Learning: Study modern fabrication technologies (7nm, 5nm) Case study: ASIC in smartphones	07	
2	Hardware Description Languages (HDL)	2.1 Introduction to Verilog/VHDL 2.2 Data types and operators 2.3 Behavioral and structural modeling 2.4 Combinational and sequential circuit design 2.5 Test bench development	08	CO2
		Self-Learning: Simulation using Modalism Design of ALU using Verilog	08	

3	Logic Synthesis and Optimization	3.1 RTL design and synthesis 3.2 Gate-level mapping 3.3 Timing constraints and analysis 3.4 Power optimization techniques 3.5 Area optimization	08	CO3
		Self-Learning: Introduction to Synopsys/Cadence tools Timing analysis case studies	08	
4	Physical Design	4.1 Floor planning 4.2 Placement strategies 4.3 Routing techniques 4.4 Clock tree synthesis 4.5 DRC and LVS checks	07	CO4
		Self-Learning: CMOS layout basics Standard cell design study	07	
5	Testing and Verification	5.1 Functional verification 5.2 Simulation techniques 5.3 Design for Testability (DFT) 5.4 Fault models and fault simulation 5.5 Built-In Self-Test (BIST)	07	CO5
		Self-Learning: Scan chain design Verification methodologies	07	
6	ASIC Applications	6.1 ASIC in communication systems 6.2 ASIC in embedded and IoT systems 6.3 Low-power ASIC design 6.4 Introduction to SoC 6.5 Industrial case studies	08	CO6
		Self-Learning: AI accelerators and ASIC chips Case study: ASIC in automotive electronics	08	
	Total		90	

Text Books:

1. CMOS VLSI Design: A Circuits and Systems Perspective –Neil H. E. Weste & David Harris
2. Application-Specific Integrated Circuits – Michael J. S. Smith
3. Digital Integrated Circuits: A Design Perspective – Jan M. Rabaey
4. ASIC Design in the Silicon Sandbox – Keith Barr

5. Introduction to VLSI Systems – Carver Mead & Lynn Conway

References:

1. Verilog HDL: A Guide to Digital Design and Synthesis – Samir Palnitkar
2. FPGA Prototyping by Verilog Examples – Pong P. Chu
3. Principles of CMOS VLSI Design – Neil H. E. Weste & Kamran Eshraghian
4. Digital System Design using VHDL – Charles H. Roth Jr.
5. System-on-Chip Design – Michael J. Flynn & Wayne Luk

Online References:

NPTEL : https://youtube.com/playlist?list=PL4PtpyzWn6WbpzsiqupukQV8Wqa_LzaqR&si=_xlsH9HzQn2LXwCP

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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
132216702	**Network Security**	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-I	IAT -II	Total					
132216702	**Network Security**	**20**	**20**	**40**	**60**	**2.5**	**--**	**--**	**100**

Rationale: Network Security is essential to protect information and network resources from cyber threats, ensuring confidentiality, integrity, and availability of data. This course helps students understand security principles, encryption, authentication, and intrusion prevention, and equips them to design and maintain secure networks, preparing them for careers in cybersecurity and IT security.

Course Objectives:

1. To understand the fundamentals of Cryptography.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To explore the various key distribution and management schemes.
4. To understand how to deploy encryption techniques to secure data in transit across data networks.
5. To learn various mechanisms for network security to protect against the threats in the networks.

Course Outcomes:

1. Implement various symmetric encryption techniques for given applications.
2. Illustrate various public key encryption techniques.

3. Understand various key encryption mechanisms and key management strategies that can be applied for real time transactions.
4. Evaluate authentication and hash algorithms.
5. Summarize the basic network security mechanisms.
6. Basic concepts of system level security

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic Computer networking, Operating Systems Fundamentals, Introduction to Cybersecurity Concepts		
1	INTRODUCTION	Services, Mechanisms and attacks - The OSI Security Architecture- A Model for Network Security ,Classical Encryption Technique ,Symmetric Cipher Model – Substitution Technique ,Rotor Machines ,Steganography	07	CO1
		Self-Learning: OSI Security Architecture, Security Services & Mechanisms, Types of Attacks (Active/Passive), Network Security Model, Classical Encryption Techniques, Symmetric Cipher Model Substitution Ciphers (Caesar, Vigenère) Rotor Machines (Enigma machine) Steganography	07	
2	BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD (DES)	Simplified DES- Block Cipher principles – The Data Encryption Standard – The strength of DES – Confidentiality using symmetric encryption – Placement of encryption - Traffic confidentiality – Key distribution - Random number generation.	07	CO2

		Self-Learning: Simplified DES (S-DES), Principles of Block Ciphers, Working of Data Encryption Standard (DES), Strengths and Weaknesses of DES, Ensuring Confidentiality with Symmetric Encryption, Placement of Encryption in Networks (Link vs End-to-End), Traffic Confidentiality Techniques, Key Distribution Methods and Challenges, Random Number Generation for Cryptography	07	
3	PUBLIC KEY ENCRYPTION AND KEY MANAGEMENT	Introduction to number theory – Public key cryptography and RSA – Key Management Diffie-hellman Key exchange	07	CO3
		Self-Learning: Basics of Number Theory (Primes, GCD, Modular Arithmetic), Principles of Public Key Cryptography, Working of RSA algorithm (RSA), Key Management in Public Key Systems, Diffie-Hellman key exchange – How two parties securely share a key	07	
4	CRYPTOGRAPHY AND NETWORK SECURITY	Authentication requirements – Authentication functions – message authentication codes – Hash functions – Security of hash functions and MAC'S – MD 5 (Message Digest Algorithm) – HMAC. Digital Signatures and authentication protocols: Digital Signatures – Authentication protocols – Digital Signature Standard – Kerbews – X.509 Authentication Service	08	CO4
		Self-Learning: Two-Factor and Multi-Factor		

08

		Authentication, Biometric Authentication (Fingerprint, Face, Iris) One-Time Passwords (OTP) and Time-based OTP (TOTP), Public Key Infrastructure (PKI) Concepts Certificate Authorities (CAs) and Trust Models, X.509 Authentication Service (X.509 Authentication Service)		
5	NETWORK SECURITY AND SYSTEM SECURITY	Electronic Mail Security – IP Security – Web Security – Intruders – Malicious S/Ws – Firewalls	08	CO5
		Self-Learning: Electronic Mail Security: PGP, S/MIME, IPSec – IP Security concepts Web Security: HTTPS, SSL/TLS, Intruders: Types and Detection Methods, Malicious Software: Viruses, Worms, Trojans, Ransomware, Firewalls: Types, Deployment, and Functions	08	
6	NETWORK SECURITY APPLICATIONS	Secure Email Systems – PGP, S/MIME Web Security – HTTPS, SSL/TLS, Secure Browsing, Virtual Private Networks (VPNs), Secure Cloud Computing, Wireless Network Security – WPA2/WPA3, Mobile and IoT Security Applications, Security in Online Banking and E-Commerce, Case Studies of Real-World Secure Systems	08	CO6
		Self-Learning: How PGP and S/MIME secure emails, HTTPS and SSL/TLS for safe web communication, VPN Types and Usage, Security Measures in Cloud Computing Wi-Fi Security: WPA2 vs WPA3, Mobile App and IoT Device Security Practices, Security Protocols in Online Banking and E-Commerce, Case Studies: Real-World Applications of Network Security	08	
	Total		90	

Text Books:

1. Behrouz A. Forouzan, Cryptography and Network Security, 4/e, McGraw-Hill Education, 2017
2. William Stallings, Network Security Essentials: Applications and Standards, 6/e, Pearson, 2017

References:

1. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: Private Communication in a Public World, 2/e, Pearson, 2002
2. W. Richter, SSL & TLS: Designing and Building Secure Systems, 1/e, Addison-Wesley, 2000
3. Douglas R. Stinson and Maura Paterson, Cryptography: Theory and Practice, 4/e, CRC Press, 2019
4. Yehuda Lindell and Jonathan Katz, Introduction to Modern Cryptography, 2/e, CRC Press, 2014
5. Rick Lehtinen, Deborah Russell, and G.T. Gangemi, Computer Security Basics, 2/e, O'Reilly Media, 2006

Online References:

NPTEL course: https://onlinecourses.nptel.ac.in/noc25_ee54/preview

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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
132216703	Advanced Networking Technologies	3		-	45	-	-	45	90	3

Course Code	Course Name	Theory					Term work	Prat / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
132216703	**Advanced Networking Technology**	**20**	**20**	**40**	**60**	**2.5**	**–**	**–**	**100**

Rationale:

Advanced networking technologies are crucial for modern digital infrastructure, enabling efficient communication, enhanced security, and innovative applications across various industries. They drive digital transformation by facilitating data-driven technologies like IoT, AI, and cloud computing, supporting reliable, high-performance communication. These technologies are not just about connectivity; they are about enabling new business models, improving user experiences, and ensuring robust security.

Course Objectives:

1. Understand the characteristic features of Various Wireless networks.

2. Introduce the need for network security and safeguards

3. Understand the characteristic features of ATM networks.

Course Outcomes:

After successful completion of the course students will be able to:

1. Appreciate the need for Wireless networks and study the IEEE 802.11 Standards

2. Comprehend the significance of Asynchronous Transfer Mode(ATM).

3. Analyze the importance of Optical networking.

4. Demonstrate knowledge of network design and security and management.

5. Understand the concept of multimedia networks.

6. Comprehend the significance of Network Design.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Wireless LAN and WAN Technologies	Introduction to Wireless networks : Infrastructure networks, Ad-hoc networks, IEEE 802.11 architecture and services ,Medium Access Control sub-layers,CSMA/CA, Physical Layer, 802.11,Security considerations Asynchronous Transfer Mode (ATM): Architecture, ATM logical connections, ATM cells , ATM Functional Layers, Congestion control and Quality of service	08	CO1
		Self-Learning: Study basics of wireless networks, IEEE 802.11 architecture, MAC & CSMA/CA, and ATM concepts including architecture and QoS.	08	

II	Optical Networking	SONET: SONET/SDH, Architecture, Signal, SONET devices, connections, SONET layers, SONET frames, STS Multiplexing, SONET Networks WDM, DWDM: Frame format, DWDM architecture ,Optical Amplifier , Optical cross connect Performance and design considerations.	07	CO2
		Self-Learning: Learn SONET/SDH architecture, frames, multiplexing, and WDM/DWDM concepts with optical devices and performance factors.	07	
III	Routing in the Internet	Intra and inter domain Routing, Unicast Routing Protocols: RIP, OSPF, BGP Multicast Routing Protocols ,Drawbacks of traditional Routing methods	08	CO3
		Self-Learning: Understand routing types (intra/inter-domain), protocols like RIP, OSPF, BGP, multicast routing, and limitations of traditional routing.	08	
IV	Network Security	Security goal, Security threats, security safeguards, firewall types and design, IP TABLES. Internet Security: Network Layer Security, Transport Layer Security, Application Layer Security	08	CO4
		Self-Learning: Study security goals, threats, safeguards, firewall design, IP tables, and security at network, transport, and application layers	08	
V	Multimedia Information and Networking	Compression Fundamentals, Digital Representation, Compression techniques, Multimedia Communication across networks, RTP, RTSP, SIP,H..323	07	CO5
		Self-Learning: Learn multimedia data representation, compression techniques, and protocols like RTP, RTSP, SIP, and H.323.	07	

VI	Network Design	3 tier Network design layers: Application layer, Access layer. Backbone layers, Ubiquitous computing and Hierarchical computing	07	CO6
		Self-Learning: Understand 3-tier network design, backbone structure, and concepts of ubiquitous and hierarchical computing.	07	
Total			90	

Text Books:

1. Behrouz A. Forouzan, "Data communication and networking ", McGraw Hill Education, Fourth Edition.
2. J F. Kurose & KW. Ross: Computer Networking- A Top-down Approach featuring the Internet, 3rd edition,
3. Darren L. Spohn , "Data Network Design" , McGraw Hill Education ,Third edition
4. William Stallings, "Data and Computer communications", Pearson Education, 10th Edition

Reference Books:

1. K. R. Rao et al: Multimedia Communication Systems, Prentice-Hall of India,.

2. Deven Shah , Ambavade, "Advanced Communication Networking"

3. Beherouz A Forouzan , "TCP /IP Protocol Suite" , Tata McGraw Hill Education ,4th edition

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106243
2.	https://onlinecourses.nptel.ac.in/noc23_cs35/preview

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.

- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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	
132216704	Statistical Learning for Data Science	3		--	45	-	--	45	90	3

Course Code	Course Name	Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
132216704	Statistical Learning for Data Science	20	20	40	60	2.5	--	--	100

Rationale: Statistical Learning for Data Science focuses on statistical methods and machine learning techniques used to analyze, interpret and model complex datasets. The course provides foundational knowledge required for predictive analytics and intelligent decision making in engineering and real-world data-driven applications.

Course Objectives:

1. To understand the principles of statistical learning and its importance in data science applications.
2. To learn statistical methods for analyzing, modeling, and interpreting data.
3. To apply regression, classification, and clustering techniques for solving real-world problems.
4. To develop skills in evaluating and improving predictive models.
5. To understand dimensionality reduction and feature selection techniques.
6. To apply statistical learning concepts using modern data science tools.

Course Outcomes:

1. Understand statistical learning concepts and the difference between supervised and unsupervised learning.
2. Apply statistical methods to summarize and analyze datasets.
3. Implement regression models for prediction and analysis.

4. Apply classification techniques for decision-making problems.
5. Perform clustering and dimensionality reduction for large datasets.
6. Evaluate and validate machine learning models for accurate prediction.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic Statistics, Probability Theory, Programming using Python/R, Fundamentals of Data Science		
1	Introduction to Statistical Learning	1.1 Vision, Mission, Course Outcomes and Syllabus Discussion 1.2 Introduction to Statistical Learning 1.3 Difference between Machine Learning and Statistical Learning 1.4 Types of Learning: Supervised, Unsupervised and Reinforcement 1.5 Bias-Variance Tradeoff 1.6 Training, Validation and Testing Data 1.7 Applications of Statistical Learning in Data Science	07	CO1
		Self-Learning: Evolution of Statistical Learning. Applications in Healthcare and Finance	07	
2	Statistical Foundations for Data Science	2.1 Descriptive Statistics 2.2 Measures of Central Tendency and Dispersion 2.3 Probability Distributions 2.4 Normal Distribution and Z-score 2.5 Sampling Methods 2.6 Hypothesis Testing	08	CO2
		Self-Learning: Statistical analysis using Python. Visualization of distributions.	08	
3	Describing Relationships	3.1 Simple Linear Regression 3.2 Multiple Linear Regression 3.3 Polynomial Regression 3.4 Logistic Regression 3.5 Model Evaluation Metrics (MSE, RMSE, R^2) 3.6 Overfitting and Underfitting	08	CO3
		Self-Learning: Regression implementation using Python Regularization techniques (Ridge, Lasso)	08	

4	Classification Methods	4.1 Introduction to Classification 4.2 k-Nearest Neighbor (kNN) 4.3 Naïve Bayes Classifier 4.4 Decision Trees 4.5 Support Vector Machines (SVM) 4.6 Confusion Matrix and Performance Metrics	08	CO4
		Self-Learning: Comparison of classification algorithms Cross-validation techniques	08	
5	Unsupervised Learning	5.1Clustering Concepts 5.2k-Means Clustering 5.3Hierarchical Clustering 5.4Dimensionality Reduction 5.5Principal Component Analysis (PCA) 5.6 Applications of Clustering	07	CO5
		Self-Learning: Feature selection methods Visualization of clusters	07	
6	Model Evaluation and Advanced Topics	6.1 Cross Validation Techniques 6.2 Bootstrapping 6.3 Ensemble Methods (Random Forest,Boosting) 6.4 Introduction to Deep Learning 6.5 Ethical Issues in Data Science 6.6 Real-world Applications of Statistical Learning	07	CO6
		Self-Learning: 7. Cloud platforms for Data Science 8. Automated Machine Learning	07	
	Total		90	

Text Books:

1. An Introduction to Statistical Learning – Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.

2. The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman..

References:

1. Pattern Recognition and Machine Learning – Christopher M. Bishop.

2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron.

Online References:

1. NPTEL – Statistical Learning Courses

2. Coursera – Machine Learning Specialization

3. Analytics Vidhya Tutorials

4. Kaggle Learning Resources

Assessment:

Internal Assessment (IA) – 40 Marks

- Two compulsory Internal Assessment Tests (IATs) of **20 marks each** will be conducted.
- **IAT-I** will cover three CO's and **IAT-II** will cover the remaining three CO's (Course Outcomes).
- Duration of each test: **1 hour**.
- The **summation of both tests** will be considered for IA marks.

End Semester Examination (ESE) – 60 Marks

- Duration: **2 Hours 30 Minutes**
- Question paper consists of **six compulsory questions**, **10 marks each**.
- Questions will be set module-wise: Q1 – Module I, Q2 – Module II, Q3 – Module III and so on...
- Each question may have **two alternatives (Option A / Option B)** from the same module.
- Both options should be of **similar difficulty level** and assess similar learning outcomes.
- Internal choice may be provided within questions.
- Questions should cover the **entire syllabus**, all Course Outcomes, and different levels of learning as per **Bloom's Taxonomy**.

Note: -

1. **Internal Assessment (IA) – 40 Marks + End Semester Examination (ESE) – 60 Marks = Total – 100 Marks**
2. **No questions shall be asked from self-learning modules in either the Internal Assessment or the End Semester Examination.**

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
98451609	Professional Communication Ethics	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-I	IAT-II	Total					
98451609	Professional Communication Ethics	-	-	-	-	-	25	-	25

Rationale:

The syllabus is designed to help students face the corporate requirement with respect to interpersonal skills, resume drafting, presentation giving and to crack the interview.

Course Objectives:

1) To develop students' interpersonal and professional communication skills.
2) To train in group discussion techniques and collaborative communication for selection processes and teamwork.
3) To prepare effective resumes and perform confidently in interviews.
4) To train students to answer confidently and cracked HR interview.
5) To build competence in drafting notices, agendas, and minutes.

6) To enhance the ability to deliver structured presentations and prepare professional reports.

Course Outcomes:

CO1: Explain the concepts and importance of interpersonal skills in professional environments.
CO2: Describe the structure, types, and evaluation criteria of group discussions.
CO3: Explain the principles and components of effective resume writing.
CO4: Describe interview processes, techniques, and professional etiquette.
CO5: Explain formats and principles of formal communication including notices and meetings.
CO6: Describe the structure and techniques of presentations and report writing.
Prerequisite: Professional Communication & Ethics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Interpersonal Skills**	Definition, importance, and scope of interpersonal skills, Components of interpersonal skills: Emotional Intelligence (self-awareness, self-regulation, motivation, empathy, social skills), Leadership and teamwork concepts, Communication in teams: barriers and effectiveness, Empathy and assertiveness: meaning and significance, Conflict management: types, causes, and resolution strategies	5	CO1
		Self-Learning Topics: Self-assessment of interpersonal skills via SWOT analysis.	5	
2.	**Group Discussion**	Purpose of Group Discussion in recruitment and teamwork, Types of GD: Topic-based, case-based, abstract, activity-based, Technical vs non-technical GD, Structure of GD: initiation, discussion flow, conclusion, Evaluation parameters: clarity, content, communication skills, leadership, GD etiquette: turn-taking, listening, body language, summarizing, Do's and Don'ts in GD.	5	CO2
		Self-Learning Topics: Latest GD topics via (Current affairs, social issues, technology)	5	
3.	**Resume building**	Purpose and importance of resume and CV, Types of resumes: chronological, functional, combination, Key sections of a resume: Objective/Summary, Education, Skills, Projects and achievements,	4	CO3

		Principles of effective resume writing: clarity, conciseness, relevance, Resume customization for different job roles.		
		Self-Learning Topics : Industry specific resume formats (IT, Core, Engineering, Managements).	4	
4.	**HR / Personal Interviews**	Meaning and types of interviews (HR, technical, behavioural), Common HR interview questions and expected responses, STAR method for answering behavioural questions, Interview etiquette: dress code, body language, communication style, Handling stress questions and tricky situations, Basic interview preparation strategies.	5	CO4
		Self-Learning Topics : Frequently asked HR and behavioural interview questions.	5	
5.	**Notice, Agenda and Meeting**	Features of formal English: tone, clarity, precision, Types of notices : circulars, warnings, announcements, Format and structure of notices, Agenda of meetings: meaning, elements, and format, Minutes of meetings: purpose, structure, and recording decisions, Importance of professional documentation.	5	CO5
		Self-Learning Topics: Study of real meeting, agendas and minutes (Corporate samples).	5	
6.	**General Topic Presentation & Report Making**	Principles of effective presentations, Structure of presentation: introduction, body, conclusion, Audience analysis and communication objectives, Presentation techniques: voice modulation, pacing, transitions, Slide design principles: simplicity, bullet points, visual clarity	6	CO6
		Self-Learning Topics: Learning Different types of reports (Technical, survey, analytical)	6	
	Total		60	

Sr. No.	List of Assignment
1.	Case Study on Any 1 Interpersonal Skills.
2.	Few HR PI Questions and their answers.
3.	Do's and Don't's of GD to the kept in mind while participating in a GD.
4.	Corporate meeting – Frame Notice, Agenda, and minutes of the meeting.
5.	Short report format and a case study for the same.

References

- Communication Skill for Engineers & Scientists (2nd Edition) by Sangeeta Sharma & Mohan N. Mishra.
- Art of Effective communication in group discussion and interview by O. P. Singh.

Online References:

Sr	**Free Online Courses**
1	LPU Blog: Comprehensive GD guide with techniques, frameworks, phrases, do's/don'ts, and topic types (campus to corporate): https://www.lpu.in/blog/from-campus-to-corporate-the-ultimate-guide-to-master-group-discussion/
2.	Tech Interview Handbook: ATS-friendly resume guide for software engineers (templates, keywords, structure, tools): https://www.techinterviewhandbook.org/resume/

Assessment:

Term work: Term work shall consist of general, social topic analysis, presentation.
Term work general must include at least 4 to 5 assignments.
Term work marks – (Total 25 marks)
Presentation PPT slides – 10 marks
Assignments – 10 marks
Attendance – 5 marks