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 INFORMATION TECHNOLOGY

Curriculum TY B.Tech 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

Dear Stakeholders

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

Under NEP 2020's emphasis on experiential, interdisciplinary, and outcome-based education, we have adopted a theme-based model where each semester focuses on real-world problem statements, drawn from local and global challenges mapped to relevant and the United Nations Sustainable Development Goals (UN SDGs) and supported by IDEA Lab for hands-on innovation and research — from design thinking to prototyping and product development. This approach not only fosters technical proficiency but also nurtures ethical leadership, social responsibility, and the entrepreneurial mindset required to become change-makers.

Moreover, in line with the National Credit Framework (NCRF) and the latest NBA accreditation guidelines, we have restructured the Third year Btech (Sem V and VI) to ensure credit uniformity. Our curriculum's flexibility allows us to swiftly incorporate emerging technologies and stakeholder feedback, minimizing the traditional four-year revision cycle.

I appreciate and thank Mr Utsav Tiwari, COO Rahul Education and Principal, Prof. Dr. Umesh S. Bhadade of Shree L R Tiwari College of Engineering for their valuable inputs. I extend my sincere gratitude to the contributors from academia, industry, and our Board for their invaluable insights—your guidance has been instrumental in shaping a programme that we trust will exceed the expectations of all our stakeholders.

I look forward to your constructive feedback and approval, as we collectively uphold SLRTCE's vision of nurturing technically competent, ethically grounded, and socially conscious IT professionals prepared for the challenges of the 21st century.

Dr. Vikas Kaul
Chairperson, Board of Studies (IT), SLRTCE

A. 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 Information Technology

(TY 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					
2615211501	PCC	Web Technology	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
2615211502	PCC	Data Mining and Business Intelligence	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
2615211503	PCC	Computer Networks	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
2615212504	PCC LAB	Web Analytics and Mining Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
2615212505	PCC LAB	Network Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
2615212506	PCC LAB	IDEA LAB - 5	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
261522157XX	PEC-I	Program Elective Course -I	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100

269931158WW	MDM-II	Multidisciplinary Minor Course -II	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	--	--	100
2615412509	VSEC	MAD& PWA Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	--	25
2699512510XX	OE-III*	Open Elective-III	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**
26152215701	Computer Graphics and Multimedia System
26152215702	Distributed Computing
26152215703	Advance Database Management Technology
26152215704	Principles of Analog and Digital Communication
26152215705	Green IT

Open Elective-III		
SR NO.	**Course Code**	**Name of the Course**
1	**269951251001**	International Financial Management
2	**269951251002**	Marketing Management - I
3	**269951251003**	HR Analytics
4	**269951251004**	Operations and Supply Chain Management
5	**269951251005**	Quantitative Investment Management
6	**269951251006**	Economics of Banking and Finance Markets
7	**269951251007**	Corporate Finance
8	**269951251008**	Principles of Behavioral Economics

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 Information Technology

(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					
2615211601	PCC	AIDS I	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
2615211602	PCC	Cryptography and Network Security	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
2615211603	PCC	Microcontroller and Embedded Programming	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
2615212604	PCC LAB	Data Science Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
2615212605	PCC LAB	Security Lab	--	--	2	--	--	30	--	30	1	--	--	--	--	--	25	25	50
2615812606	PROJECT	Dissertation- I	--	--	2[$]	--	--	30	--	30	1	--	--	--	--	--	50	50	100
261522167XX	PEC-II	Program Elective Course- II	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100

269931168 W W	MDM-III	Multidisciplinary Minor Course -III	3	--	--	45	--	--	45	90	3	20	20	40	60	2.5	–	–	100
2698451609	VEC	Professional Communication and Ethics	2	--	--	30	--	--	30	60	2	–	–	–	–	–	25	–	25
2699512610 X X	OE-IV*	Open Elective-IV	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**
26152216701	Image Processing
26152216702	High Performance Computing
26152216703	Information Retrieval Systems
26152216704	Wireless Technology
26152216705	Disaster Management and Mitigation

Open Elective-IV		
SR NO.	**Course Code**	**Name of the Course**
1	**269951261001**	Moral Thinking: Introduction to Values and Ethics,
2	**269951261002**	Ethics in Engineering Practice,
3	**269951261003**	Introduction to Psychology,
4	**269951261004**	Direct foreign language courses (like German, French),
5	**269951261005**	Financial Institutions and Markets,
6	**269951261006**	Investment Management
7	**269951261007**	Introduction to Sociology
8	**269951261008**	Cultural Studies Language for Competitive Exams

Note:

1. 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.

2. 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

3. 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.

4. $ indicates work load of learner (not faculty), for Dissertation- I.

student group and load of faculty per week.

Dissertation- I

Student can form groups with minimum 2 (Two) and not more than 4 (four)

Faculty Load:

In semester VI – $^1/_2$ hour per week per project group

5. * Recommended that OE to be offered in the form of MOOCs (NPTEL /Swayam).

T.Y. B.Tech Syllabus **SEM V**

Semester 5

Intelligent, scalable and inclusive platforms for Digital Empowerment and Sustainable Futures

(Harnessing Intelligent, Ubiquitous, and Sustainable Technologies to Build an Inclusive Digital Ecosystem for Mira Bhayandar and Beyond)

This theme blends intelligence (CN,BI, Web), and sustainability (Green IT) to focus on urban challenges (traffic, waste, e-health, cyber safety, energy use). It ensures that technology growth = sustainable + ethical + inclusive growth.

UN SDGs Alignment

- SDG 3: Good Health & Well-Being
- SDG 7: Affordable & Clean Energy
- SDG 9: Industry, Innovation & Infrastructure
- SDG 11: Sustainable Cities & Communities
- SDG 12: Responsible Consumption & Production
- SDG 13: Climate Action
- SDG 16: Peace, Justice & Strong Institutions

Theme : Urban System

1. **To study challenges in urban systems and demonstrate a very basic system for improved service efficiency.**
2. **To observe urban resource usage and demonstrate a very basic system for better coordination.**
3. **To study urban service practices and demonstrate a very basic system supporting sustainability.**
4. **To observe operational patterns in urban environments and demonstrate a very basic system for improvement.**
5. **To study urban infrastructure needs and demonstrate a very basic system for better management.**
6. **To study mobility-related challenges in urban environments and explore approaches that improve movement and accessibility.**
7. **To investigate the interaction between urban services and citizens and identify opportunities for improved service delivery.**
8. **To observe public service usage and demonstrate a very basic system for efficient operation.**
9. **To study urban system behavior and demonstrate a very basic system supporting organized functioning.**
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	
2615211501	Web Technology	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					
2615211501	Web Technology	20	20	40	60	2.5	--	--	100

Rationale:

Web technologies play a vital role in developing modern interactive and data-driven applications. This course introduces students to the fundamental concepts of web protocols, web analytics and semantic web technologies used in modern web systems. It provides knowledge of scripting languages such as JavaScript and TypeScript for developing dynamic web applications. The course also covers modern frontend frameworks like React and Angular for building responsive user interfaces. Backend development using Node.js along with database integration using MongoDB is also introduced. In addition, students learn to develop RESTful APIs and web services using Express and Flask frameworks. Overall, the course prepares students to design and develop full-stack web applications using modern web technologies

Course Objectives:

1. To understand the fundamentals of web technologies, including web protocols, web analytics, and semantic web concepts used in modern applications.
2. To learn and apply modern JavaScript and TypeScript for building dynamic, scalable, and maintainable web applications.
3. To design and develop interactive single-page applications using modern frontend frameworks such as React and Angular.
4. To develop server-side applications using Node.js and integrate them with databases like MongoDB.

5. To build RESTful APIs and web services using frameworks such as Express.js and Flask.
6. To understand modern web application architecture, including MERN stack, API integration, and implement secure web applications using authentication and web security practices.

Course Outcomes: Student will able to

1. Explain web protocols, web analytics concepts, and semantic web technologies used in modern web applications. *(L1, L2)*
2. Apply modern JavaScript (ES6+) and TypeScript to develop interactive and scalable web applications. *(L2, L3)*
3. Design and develop responsive single-page applications using modern frontend frameworks like React and Angular. *(L3, L4, L5)*
4. Develop backend applications using Node.js and integrate them with MongoDB. *(L3, L4)*
5. Implement RESTful APIs and web services using Express.js and Flask. *(L3, L4)*
6. Design and build full-stack web applications using MERN architecture, apply API integration, and implement authentication and security mechanisms. *(L4, L5, L6)*

Prerequisite: Object Oriented Programming, HTML and CSS

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Web Technology**	Domain Name System (DNS), HTTP and HTTPs Protocol, Transport Layer Security (TLS) Web Analytics and Semantic: Evolution of Web 1.0, Web 2.0 and Web 3.0, Introduction to Web Analytics, Web Analytics 2.0 & 3.0, Clickstream analysis, Strategy for choosing web analytics tools overview, Characteristics and components of Semantic Web, Semantic Web stack, Ontology, RDF and SPARQL	**7**	**CO1**
		Self-Learning: Semantic Web vs Artificial Intelligence, SPARQL vs SQL, Nginx, Web server performance optimization techniques, Applications of Semantic Web in search engines, Web analytics tools (Google Analytics overview), **Case Study:** Study how a search engine like Google uses DNS, HTTP/HTTPS, TLS, web analytics, and semantic web technologies to improve search results and user experience.	**7**	
II	**JavaScript ES6 and**	JavaScript Fundamentals: Introduction to ES6, Difference between ES5 and ES6, Variables and data types, Conditional statements and loops, Functions and events, Arrow functions, Classes and inheritance, Iterators and	**8**	**CO2**

	TypeScript Programming	Generators, Promises & Async/Await (Modern Asynchronous Programming), Client–server communication TypeScript: Overview of TypeScript and architecture, Environment setup, Data types and variables, Operators and control structures, Functions and classes, Modules in TypeScript		
		Self-Learning: JavaScript vs TypeScript, Fetch API and working with external APIs, Debugging JavaScript applications, **Case Study:** Develop a dynamic web application using JavaScript ES6 and enhance it using TypeScript for type safety and better code management.	**8**	
III	**Frontend Frameworks – React and AngularJS**	React Fundamentals: Installation and environment setup, Components and lifecycle, Hooks (use State, use Effect, use Context, custom hooks), Refs, State and Props, React Router (SPA), Forms and event handling, MVC Architecture, Flux Angular Framework Overview: Introduction to Angular, Angular modules, Directives and expressions, Data binding, Filters, Scope, Controllers and services, Dependency injection, Form validation and routing, Using Angular with TypeScript, Routing using ng-Route, ng-Repeat, ng-style, Built-in Helper Functions	**7**	**CO3**
		Self-Learning: UI design, Forms, Events, Animations, React vs Angular vs Vue.js, React Native, React Native for mobile application development, Progressive Web Applications (PWA), **Case Study:** Design a single-page web application using React or Angular with routing, components, and form handling.	**7**	
IV	**Node.js Backend Development and Database Integration**	Node.js Backend Development: Introduction and Environmental setup to Node.js, Creating first Node.js application, Callback concept and event loop, REPL environment, Event emitter, Buffers, Streams, File system and networking modules Database Integration: Introduction to MongoDB, SQL vs NoSQL databases, MongoDB data types Adding the MongoDB Driver to Node.js, Connecting Node.js with MongoDB, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Schema design and validation using Mongoose, CRUD operations,	**8**	**CO4**
		Self-Learning: Database indexing and performance optimization, Logging and debugging in Node.js	**8**	

		applications, Mongoose vs native MongoDB driver, Data validation techniques in MongoDB, **Case Study:** Build a Node.js backend application integrated with MongoDB for managing and storing application data.		
V	**Express Framework, REST APIs and Flask**	Express Framework: Introduction to Express.js, Express router, Express generator, Authentication mechanism, Session management, Integrating Express with React Web APIs: REST API concept and architecture, Principles of REST APIs, API design patterns, CRUD operations FLASK: Introduction to Flask, Routing and URL building, HTTP methods, Request & Response Handling Cookies and file uploading	**7**	**CO5**
		Self-Learning: Flask vs Django, Middleware in Express.js, **Case Study:** Develop a RESTful API using Express.js and implement a small web service using Flask.	**7**	
VI	**AJAX, Modern Web Application Architecture and Web Security**	AJAX: Introduction and Working Developing RIA using AJAX Techniques: CSS, HTML, DOM, XML HTTP Request, JavaScript, PHP, AJAX as REST Client Introduction to Open-Source Frameworks and CMS for RIA: WordPress (Traditional + Headless CMS), Django, Strapi, Sanity **Modern Web Application Architecture** • Introduction to MERN Stack • State management techniques • API integration in frontend **Web Security** JWT (JSON Web Token) Authentication, OAuth Basics, Session vs Token Authentication	**8**	**CO6**
		Self-Learning: Introduction to GraphQL AND Next.Js, Commercial deployment of web applications, Applications of AJAX in Blogs, Wikis and RSS feeds, GraphQL vs REST APIs, CI/CD for web application deployment, **Case Study:** Develop a full-stack web application using MERN architecture with AJAX-based API communication.	**8**	

Text Books:

1. Rediscovering JavaScript, Master ES6, ES7, and ES8, By Venkat Subramaniam · 2018
2. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly.

3. Learning Node.js Development, Andrew Mead, Packt Publishing
4. RESTful Web API Design with Node.js 10, Valentin Bojinov, Packt Publication
5. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc.
6. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications.
7. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly.
8. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions.
9. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress, 2019.

References:

1. Web Development with Node and Express, Ethan Brown, O'Reilly
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications.
3. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress
4. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison- Wesley Professional
5. Roy Derks, React Projects (2nd Edition), Packt Publishing – includes projects using Next.js and GraphQL for full-stack application

Online References:

Sr. No.	Website Name
1.	https://www.mongodb.com/mern-stack
2.	https://www.apollographql.com/docs
3.	https://nextjs.org/docs
4.	https://nodejs.org/en/docs
5.	https://react.dev/learn

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	
2615211502	Data Mining & Business Intelligence	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					
2615211502	Data Mining & Business Intelligence	20	20	40	60	2.5	--	--	100

Rationale:

Data Mining and Business Intelligence play a vital role in extracting meaningful insights from large volumes of data to support effective decision-making. This course introduces students to the fundamental concepts of data warehousing, data preprocessing, and knowledge discovery techniques used in modern data-driven systems. It provides knowledge of data mining methods such as classification, clustering, association rule mining, and predictive analysis. The course also covers statistical techniques, data similarity measures, and model evaluation methods for accurate analysis. In addition, students learn to use business intelligence tools to create reports and visualizations for decision support. Overall, the course prepares students to analyze complex datasets and develop intelligent solutions for real-world business applications.

Course Objectives:

1 To introduce the concept of data warehouse & data Mining as an important tool for enterprise data management and as a cutting-edge technology for building competitive advantage.
2 To enable students to effectively identify sources of data and process it for data mining.
3 To impart knowledge of classification, regression, validation techniques, and ensemble methods to build and evaluate accurate predictive models.
4 To provide knowledge on clustering techniques and outlier detection methods to analyze data patterns.
5 To introduce the concept of association rule mining and frequent itemset techniques for effective data analysis.
6 To impart knowledge on advanced pattern mining and business intelligence concepts, and the development of data-driven decision support systems for real-world applications.

Course Outcomes: Student will able to

1 Demonstrate an understanding of the importance of data warehousing and data mining and statistical techniques for data analysis. (L1, L2)
2 Organize and prepare the data needed for data mining using pre-preprocessing techniques. (L1, L2, L3)
3 Apply and evaluate predictive models using classification, regression, and ensemble techniques to improve accuracy and support effective data-driven decision-making. (L1, L2, L3, L4, L5)
4 Apply clustering techniques and outlier detection methods to analyze data patterns and identify anomalies. (L1, L2, L3)
5 Apply association rule mining and frequent itemset techniques to discover data patterns. (L1, L2, L3)
6 Develop analytical interfaces and apply advanced pattern mining techniques for data driven decision support systems. (L1, L2, L3, L4, L5, L6)

Prerequisite: Database Management System

DETAILED SYLLABUS:

Sr. No	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Data Warehouse With Fundamentals of Data Mining**	DWH characteristics, Dimensional modelling: Star, Snowflakes, OLAP operation, OLTP vs OLAP Data Mining as a step in KDD, Kind of patterns to be mined, Technologies used, Data Mining applications. Types of Attributes, Statistical Description of Data, Measuring Data Similarity and Dissimilarity.	**8**	**CO1**

	And Data Exploration	**Self-Learning**: Data Marts, Major issues in Data Mining. **Case Study**: Real-world case studies of Data Warehousing implementation in industries, Study of real-life applications of Data Mining in healthcare, finance, and e-commerce, Research on emerging trends in Data Warehousing and Data Mining (Big Data, Cloud-based DW)	**8**	
II	**Data Preprocessing**	Why pre-processing? Data Cleaning, Data Integration, Data Reduction: Attribute Subset Selection, Histograms, Clustering, Sampling, Data Cube aggregation, Data transformation and Data Discretization: Normalization, Binning, Histogram Analysis.	**7**	**CO2**
		Self-Learning: Data Visualization, Concept hierarchy generation. **Case Study:** Data cleaning in real-world datasets, Study of data pre-processing in big data environments (Hadoop, Spark)	**7**	
III	**Classification and Prediction**	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naive Bayes Classifier. Prediction: Structure of regression models; Simple linear regression, Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation, Bootstrap, Introduction of Ensemble methods, Bagging, Boosting, AdaBoost and Random Forest.	**8**	**CO3**
		Self-Learning: Multiple linear regression, logistic regression, Random Forest, nearest neighbor classifier, SVM. **Case Study:** Predictive modelling in real-world applications, Practical use of validation techniques.	**8**	
IV	**Clustering and Outlier Detection**	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN. What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based.	**7**	**CO4**

		Self-Learning: Hierarchical methods: Chameleon, Density based methods: OPTICS, Grid based methods: STING, CLIQUE. **Case Study:** Clustering applications in customer segmentation and marketing, Study of challenges in clustering high-dimensional data.	**7**	
V	**Frequent Pattern Mining**	Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from Frequent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats.	**8**	**CO5**
		Self-Learning: Association Mining to Correlation Analysis, lift, Introduction to Constraint-Based Association Mining. **Case Study:** Market Basket Analysis in retail and e-commerce, Generating and interpreting association rules using real datasets, Applications of association rule mining in recommendation systems.	**8**	
VI	**Advanced Pattern Mining and Business Intelligence**	Introduction to Advanced Pattern Mining: Mining Multilevel Association Rules and Multidimensional Association Rules. What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Recommendation System	**7**	**CO6**
		Self-Learning: Clickstream Mining, Market Segmentation, Retail industry, Telecommunications industry, Banking & finance CRM, Epidemic prediction, Fake News Detection, Cyberbullying, Sentiment Analysis etc. **Case Study:** Multilevel and multidimensional association rule mining, building a basic recommendation system using Python	**7**	

Text Books:

1 Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.Learning
2 P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
3 Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications
4 Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley India Publications.
5 G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, 2nd Edition, Wiley India.

References:

1 Michael Berry and Gordon Linoff “Data Mining Techniques”, 2nd Edition Wiley Publications.
2 Michael Berry and Gordon Linoff “Mastering Data Mining- Art & science of CRM”, Wiley Student Edition.
3 Vikram Pudi & Radha Krishna, “Data Mining”, Oxford Higher Education.

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc21_cs06/preview

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.

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	
2615211503	Computer Networks	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					
2615211503	Computer Networks	20	20	40	60	2.5	--	--	100

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.

Rational:

The Computer Networks course is designed to provide students with fundamental and advanced knowledge of networking concepts, communication models, protocols, and network design principles required in modern computing environments. The course helps students understand how data is transmitted, managed, and secured across interconnected systems using OSI and TCP/IP models, transmission media, routing protocols, IP addressing, transport and application layer services. It also develops analytical and practical skills in configuring networks, understanding network devices, implementing communication protocols, and designing organizational networks using technologies such as VLAN, VPN, DHCP, DNS, and socket programming. The course prepares students for real-world networking applications, higher studies, and industry requirements in areas such as network administration, cybersecurity, cloud computing, and IoT

Course Objectives:

1. Understand the division of network functionalities into layers.
2. Understand the types of transmission media along with data link layer concepts, design issues and protocols.

3. Analyze the strength and weaknesses of routing protocols and gain knowledge about IP addressing.
4. Understand the data transportation, issues and related protocols for end-to-end delivery of data.
5. Understand the data presentation techniques used in presentation layer & client/server model in application layer protocols.
6. Design a network for an organization using networking concepts

Course Outcomes: student will able to

1. Describe the functionalities of each layer of the models and compare the Models. (L1)
2. Categorize the types of transmission media and explain data link layer concepts, design issues and protocols. (L2, L3, L4)
3. Analyze the routing protocols and assign IP address to networks. (L4)
4. Explain the data transportation and session management issues and related protocols used for end-to-end delivery of data. (L1, L2)
5. List the data presentation techniques and illustrate the client/server model in application layer protocols. (L1, L3).
6. Use of networking concepts of IP address, Routing, and application services to design a network for an organization (L3)

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Computer Networks**	Introduction to Computer Networks, Goals of Computer Networks, Uses of Computer Networks, Network Topology and its Types: Bus, Star, Ring, Tree, Mesh. Network Hardware, Network Software, Network Classification: PAN, LAN, MAN, WAN and Comparison. Protocol Layering. Reference Models: OSI and its layers in detail, TCP/IP and its layers in detail, Comparison of OSI & TCP/IP, Network Devices: Router, Switch, Hub, Bridge, Repeater, Modem, Access Point (AP), Gateway, Firewall, Network Interface Card (NIC) and their comparison.	**07**	**CO1**
		Self-learning Topics: Designing a Computer Network for a School Campus, Comparison of Home, Office, and Banking Networks, Network Topology Analysis in Organizations.	**07**	
		Physical layer: Guided Media, Unguided Media, Wireless Transmission: Electromagnetic Spectrum. Switching: Circuit-Switched Networks, Packet Switching, Structure of a Switch	**08**	**CO2**

II	**Physical Layer & Data Link Layer**	**DLL Design Issues** (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, Parity, CRC, Checksum) , Elementary Data Link protocols: Stop and Wait, Sliding Window (Go Back N, Selective Repeat), Piggybacking, HDLC **Medium Access Protocols:** Random Access, Controlled Access, Channelization. Ethernet Protocol: Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10-Gigabit Ethernet.		
		Self-learning Topics: Selection of Transmission Media for a College Campus Network, Switching Techniques in Banking Network Communication., Design and Implementation of Network Infrastructure for a Smart Hospital.	**08**	
III	**Network Layer**	Network Layer Services, Packet Switching, Network Layer Performance, IPv4 Addressing (classful and classless), Subnetting, Super netting, IPv4 Protocol, DHCP, Network Address Translation (NAT). **Routing algorithms**: Distance Vector Routing, Link state routing, Path Vector Routing. **Protocols** –RIP, OSPF, BGP. **Next Generation IP:** IPv6 Addressing, IPv6 Protocol, Transition fromIPV4 to IPV6.	**08**	**CO3**
		Self-learning Topics IP Addressing and Network Design for a University Campus, Routing Protocol Implementation in a Multi-Branch Banking Network., Migration from IPv4 to IPv6 in a Smart City Network.	**08**	
IV	**Transport Layer & Session Layer**	Transport Layer: Transport Layer Services, Connectionless & Connection-oriented Protocols, Transport Layer protocols: User Datagram Protocol: UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers. Session Layer: Session layer design issues, Session Layer protocol - Remote Procedure Call (RPC).	**08**	**CO4**
		Self-learning Topics Online Video Streaming Application Using UDP, Secure Online Banking System Using TCP, File Transfer and Network Congestion in Corporate Communication, Remote Healthcare System Using Session Layer and RPC.	**08**	

V	**Presentation Layer & Application Layer**	Presentation layer: Compression: Comparison between Lossy Compression and Lossless Compression, Huffman Coding, Speech Compression, LZW, RLE, Image Compression – GIF, JPEG. Application layer: Introduction to Application layer, Standard Client-Server Protocols: World Wide Web, HTTP, FTP, Electronic Mail: SMTP, POP3, IMAP, Domain Name System (DNS), SNMP Socket Programming: Introduction to Socket Programming, TCP vs UDP Sockets, Client-Server Communication Model.	**07**	**CO5**
		Self-learning Topics: Multimedia Content Delivery System for an E-Learning Platform, Corporate File Sharing and Email Communication System, Client-Server Chat Application Using Socket Programming	**07**	
VI	**Network Design Concepts**	Introduction to VLAN, VPN. A case study to design a network for an organization meeting the following guidelines: Networking Devices. IP addressing: Subnetting, Supernetting, Routing Protocols to be used, Services to be used: TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.	**07**	**CO6**
		Self-learning Topics: Network Design for a Multi-Department College Campus, Corporate Branch Office Network with VPN Connectivity, Smart Hospital Network Infrastructure Design	**07**	

Text Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.
2. Behrouz A. Forouzan, Data Communications and Networking ,4th Edition,Mc Graw Hill education.

References:

1. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
2. B. A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill edition, Third Edition.
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGrawHill Second Edition.
4. Khalid Sayood, Introduction to Data Compression, Third Edition, Morgan Kaufman.

Online References:

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

2.	https://swayam.gov.in
3.	https://www.coursera.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	
2615212504	Web Analytics and Data Mining 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					
2615212504	Web Analytics and Data Mining Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To study open-source tools for Web Analytics and the Semantic Web to analyze web usage and enhance intelligent web solutions.
2. To explore modern web application development using TypeScript, AngularJS, AJAX, and Flask for designing interactive and dynamic web applications.
3. To understand frontend-backend integration using REST APIs and MongoDB for building connected and data-driven web applications.
4. To understand and implement data modeling, visualization, and analysis techniques using appropriate tools and programming languages for effective data processing and interpretation.
5. To understand and implement classification and clustering techniques using appropriate tools and programming languages for effective data analysis and interpretation.
6. To explore Frequent Pattern Mining algorithms using Python or Java and apply the insights to a real-world case study through interactive Power BI dashboards for effective decision-making.

Lab Outcome

1. Understand and apply open-source tools for web analytics, semantic web applications, and TypeScript concepts in web application development. (L1, L2, L3)

2. Design and implement dynamic and single-page web applications using AngularJS and AJAX techniques. (L1, L2, L3)
3. Develop and deploy web applications using RESTful Web Services, MongoDB, and Flask for frontend-backend integration. (L1, L2, L3, L4)
4. Design and implement Star and Snowflake schemas using Power BI/Tableau, and apply data exploration and analysis techniques in Python/Java to interpret datasets effectively. (L1, L2, L3, L4, L5, L6)
5. Perform and evaluate classification (ID3, Naive Bayes) and clustering (K-means) techniques using WEKA and Python/Java to analyze and interpret data effectively. (L1, L2, L3, L4, L5)
6. Design, implement, and analyze frequent pattern mining algorithms and develop Power BI dashboards to present data insights effectively. (L1, L2L3, L4, L5, L6)

Prerequisite: Object oriented Concept, Full Stack Java, Python.

Hardware & Software Requirements:

Hardware Requirements	**Software Requirements**
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Angular IDE, Visual Studio Code, Notepad++, Python Editors, MySQL, XAMPP, MongoDB JDK Open-source data mining and BI tools like WEKA, Rapid Miner, Pentaho, Power BI

List of Experiment

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
1	**Web analytics and sematic**	Study web analytics using open-source tools like Matomo, Open Web Analytics, AWStats, Countly, Plausible. Study Semantic Web Open-Source Tools like Apache TinkerPop, RDFLib, Apache Jena, Protégé, Sesame.	**01**	**LO1**
2	**Javascript and typescript**	**Study and implementation of JavaScript for basic** web programming: Variables, Operators, Conditions, Loops, Functions, Events, Classes and Objects, Arrays, String. Implement TypeScript programs Small code snippets for programs like hello world, Calculator using TypeScript. Inheritance example using TypeScript Access Modifiers example using TypeScript	**04**	**LO2**

3	**React and Angular Js**	Frontend Frameworks – Develop simple web applications using React (components, props, state) Implement AngularJS – Events and Validations in AngularJS. (Create functions and add events, adding HTML validators, using $valid property of Angular, etc.) Create an application for like Students Record using AngularJS	**04**	**LO2**
4	**Nodejs, ExpressJs and MonogoDB**	Perform any two: 1. Installation and Configuration of Node.js and Database Integration 2. Installation and Configuration 3. Filesystem 4. Building Web Applications using Express.js 5. Build a RESTful API using MongoDB.	**02**	**LO3**
5	**Flask**	Perform any two: 1. Design Feedback Form using Flask. 2. Design Weather App using Flask. 3. Web application using React and Flask. 4. Create a complete Machine learning web application using React and Flask.	**04**	**LO3**
6	**AJAX**	Perform any two: 1. Write a JavaScript program for a AJAX. 2. Write a program to use AJAX for user validation using and to show the result on the same page below the submit button. 3. Design and develop small web application using AJAX, HTML and JSP. 4. Case Study on Modern Web Application Architecture	**03**	**LO2**
7	**Designing Data Warehouse**	Tutorial on Design Star Schema and Snowflake Schema using Power BI / Tableau	**02**	**LO4**
8	**Data preprocessing**	Implement using tools or languages like JAVA/ python/R Data Exploration (boxplot) Data preprocessing (Binning)	**02**	**LO4**

9	**Data Classification**	Perform and Evaluate ID3 Classification using WEKA open-source tool. Implementation of Naive Bayesian Classification Algorithms using JAVA/ python.	**02**	**LO5**
10	**clustering**	Implementation of K-means clustering using Python/Java	**02**	**LO5**
11	**Pattern Mining**	Implementation of Frequent Pattern Mining Algorithm using Python / Java	**02**	**LO6**
12	**Business Intelligence**	Detailed case study and creation of dashboard using Power BI .	**02**	**LO6**

Text Books:

1. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", Wiley Publishing, Inc, 1st Edition, 2009.
2. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2019 Edition.
3. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly, 2018 Edition.
4. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 1st Edition, Wiley India.
6. Paulraj Ponniah "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" Wiley Publications

References:

1. John Davies, Rudi Studer and Paul Warren, "Semantic Web Technologies Trends and Research in Ontology-based Systems", Wiley, 2006 Edition.
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications, 2020 Edition.
3. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress, 2014 Edition.
4. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education
5. WEKA, RapidMiner Pentaho resources from the Web.

Online References:

Sr no.	**Website Name**
1	https://www.kaggle.com/learn/overview
2	Python for Data Science https://onlinecourses.nptel.ac.in/noc21_cs33/preview

Term Work: Term Work shall consist of at least 10-12 practical's based on the above list. Also Term work must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 5 (Assignment)+ 5 Marks (Attendance)

Oral Exam: An Oral exam 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	
2615212505	Networking 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					
2615212505	Networking Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To understand and analyze basic networking concepts, devices, and administration commands
2. To simulate and implement LAN topologies using Packet Tracer
3. To apply IP addressing techniques and subnetting in network design
4. To configure and analyze network protocols such as NAT and OSPF
5. To study network traffic, error detection techniques, and TCP/IP headers using protocol analyzers
6. To implement client-server communication using TCP/UDP and design a complete network system

Lab Outcomes:

1. Execute and analyze networking commands for configuration and troubleshooting. (L3, L4)
2. Demonstrate simulation and implementation of LAN topologies using Packet Tracer(L2)
3. Apply IP addressing and subnetting techniques for network configuration. (L3)
4. Configure and evaluate routing and translation protocols such as OSPF and NAT (L4)
5. Analyze network traffic, protocol headers, and error detection mechanisms. (L4)
6. Implement socket programming using TCP/UDP and design a complete network solution.(L6)

Prerequisite: C /Java

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above, Network interface card (NIC), Internet connectivity	Cisco Packet Tracer, Wireshark, Operating System: Windows / Linux

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
0	**Prerequisite**	Programming Language (C/Java), Basic commands of windows and Unix/Linux operating system. Editor commands (eg nano/ vi editor etc)	**00**	-
I	**Fundamentals of Computer Network**	Understanding Basic networking Commands: ifconfig ,ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, hostname, curl or wget, mtr, whois, tcpdump Execute and analyze basic networking commands.	**02**	**LO1**
II	**Basics of Network simulation**	Using Cisco Packet Tracer, these topologies can be designed and simulated to understand data flow, connectivity, and network performance.	**04**	**LO2**
III	**Network Design**	Network Design for an organization using the following concepts: Addressing (IP Address Assignment), Naming (DNS),Routing, Perform remote login using Telnet Server	**05**	**LO3**
	Simulation of Network Topology with	Implementation of specific Network topology with respect to Number of nodes and physical layer configuration Graphical simulation of a network with Routing Protocols (Distance		

IV	**different Protocols**	Vector/ Link State Routing) and traffic consideration (TCP, UDP) using NAM. Analysis of network performance for quality of service parameters such as packet-delivery- ratio, delay and throughput. Comparative analysis of routing protocols with respect to QOS parameters using Xgraph/gnuplot for different load conditions.	**06**	**LO4**
V	**Protocol Analyzer**	Study of various Network Protocol Analyzer Tools likeWireshark, tcp dump, Win dump, Microsoft Message Analyzer, Ettercap, Nirsoft Smart Sniff etc. Install one of the Network protocol analyzer tools and analyze the traffic Study various network protocol analyzer tools and analyze the network traffics using one of the network protocol analyzer tools.	**06**	**LO5**
VI	**Socket Programming**	Socket Programming with C/Java/python TCP Client, TCP Server UDP Client, UDP Server To study and Implement Socket Programming using TCP. To study and Implement Socket Programming using UDP Design a network for an organization using the concepts of Addressing (IP Address Assignment), Naming (DNS) and Routing. Also mention the internet working devices used	**07**	**LO6**

Text Books:

1. Data Communication & Networking Behrouz A. Forouzan McGraw Hill education.5th Edition,2014
2. Computer Networks Andrew S. Tanenbaum Pearson Education 5th Edition, 2014
3. Computer Networking: A Top- Down Approach Featuring the Internet James F. Kurose, K.
4. W. Ross Pearson Education 5th Edition, 2014

References

1. Computer Networks: A Systems Approach L. L. Peterson and B. S.DavieElsevier India 5th Edition, 2012
2. Understanding communications and Networks W. A. Shay Cengage Learning 2nd Edition 2001

3. Introduction to Data Compression Khalid Sayood, MorganKaufman Elseiver Third Edition, 2011

Online References:

Sr no.	**Website Name**
1	https://www.javati nt.com
2	https://beginnersbook.com
3	https://nptel.ac.in
4	https://www.cse.iitk.ac.in/
5	https://www.cse.iitk.ac.in/
6	https://www.cse.iitk.ac.in/
7	https://www.cse.iitk.ac.in/

List of Experiment

Sr. No.	**Experiment Title**	**LO Mapping**
1	Network System Administration: Understanding working of various networking devices using packet tracer software	**LO1**
2	Execute and analyze basic networking commands (ifconfig ,ip, traceroute, tracepath, ping, netstat, ss, dig, nslookup, route, host, arp, hostname, curl or wget, mtr, whois, tcpdump.	**LO1**
3	Implementation of LAN topologies using Packet tracer.	**LO2**
4	Implementation of IP addressing (first IP address and last IP address of a given Subnet)	**LO3**
5	Implementation of Network Address translation on packet tracer software	**LO4**
6	Implementation of OSPF protocol using packet tracer	**LO4**
7	Implementation of RIP using packet tracer	**LO4**
8	Implementation of BGP using packet tracer	**LO4**
9	Study and Implementation of CRC technique.	**LO5**
10	Study and Implementation of Hamming code technique.	**LO5**

11	Study & Analysis of TCP/IP header using Wireshark.	**LO5**
12	To setup Network transaction with Wireshark for Protocol Analysis (ICMP, TCP, HTTP).	**LO5**
13	Implement connection-oriented client server socket programming using TCP/IP.	**LO6**
14	Implementation of connectionless client server socket using UDP.	**LO6**
15	To design and configure given network. (Students should implement one Mini project Based experiment from the list or any other project in discussion with Faculty in-Charge)	**LO6**

Term Work: Term Work shall consist of at least 12 practical's 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: A Practical & Oral exam 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	
2615212506	IDEA LAB -5 (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					
2615212506	IDEA LAB – 5 (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)	25 marks
Month 2 (Formative 2)	25 marks
Month 3 (Formative 3)	25 marks

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	
261522150701	Computer Graphics & Multimedia 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					
261522150701	Computer Graphics & Multimedia System	20	20	40	60	2.5	--	--	100

Rationale:

This syllabus is designed to build a strong foundation in computer graphics and multimedia systems, starting from basic concepts and gradually progressing to advanced transformations, rendering techniques, and multimedia processing. It balances theory, algorithms, and practical implementation, preparing students for both higher studies and industry applications like game development, animation, UI/UX, and media systems.

Course Objectives:

1 To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics.
2 To emphasize on understanding Computer Graphics Algorithms.
3 To prepare the student for advanced areas in the field of Computer Graphics.
4 To introduce students for professional avenues in the field of Computer Graphics.
5 To introduce students about basic fundamentals and key aspects of the Multimedia system.
6 To equip the students for various techniques of Multimedia.

Course Outcomes:

1. Describe the basic concepts of Computer Graphics. (L1, L2)
2. Demonstrate various algorithms for basic graphics primitives. (L1, L2, L3)
3. Apply 2-D geometric transformations on graphical objects. Use various Clipping algorithms on graphical objects. (L1, L2, L3)
4. Explore 3-D geometric transformations and curve representation techniques. (L1, L2, L3)
5. Describe the basics of Multimedia Systems. (L1, L2)
6. Explore the Digital images audio & video and their related concepts. (L1, L2, L3)

Prerequisite: Basic knowledge of mathematics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Computer Graphics.**	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems, Graphics pipeline and frame buffer concept.	**7**	**CO1**
		Self-learning Topics: - Study the working of some Raster scan display devices	**7**	
II	**Output Primitives and Filling Techniques.**	Scan conversions of point, line and circle: DDA algorithm and Brenham algorithm for line drawing, Midpoint algorithm for circle, Aliasing, Antialiasing techniques like Pre filtering and post filtering, super sampling, and pixel phasing. Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm Compiler Optimizations, Loop Optimization, Function Inlining, Memory Access Optimization, Avoiding Branches.	**8**	**CO2**
		Self-learning Topics: Implementation of DDA and Bresenhams line algorithm for dotted line, dashed line, Dash-dot line etc	**8**	
		Basic 2D transformations: - Translation, Scaling, Rotation, Reflection. Matrix representation and	**7**	**CO3**

III	**Two-Dimensional Transformations and Clipping**	Homogeneous Coordinates. Composite transformation. Viewing transformation pipeline and Window to Viewport coordinate transformation. Clipping operations: Point clipping, Line Clipping. Line clipping algorithms: Cohen- Sutherland, Liang- Barsky, Polygon Clipping Algorithms: Sutherland- Hodgeman		
		Self-learning Topics: Implementation of 2D transformations like translation, rotation and scaling. Implementation of clipping algorithm	**7**	
IV	**3D Transformation, curves and fractals**	3D Transformations: Translation, Rotation, Scaling. Reflection, Composite transformations: Rotation about an arbitrary axis. Bezier Curve, B-Spline Curve. Fractal-Geometry: Fractal Dimension, Hilbert's curve, Koch Curve.	**7**	**CO4**
		Self-learning Topics: Implementation of 3D transformations, Bezier curve, Koch curve	**7**	
V	**Introduction to Multimedia systems**	Overview, Objects and Elements of Multimedia, Applications of Multimedia, Multimedia Systems Architecture – IMA, Workstation, Network, Types of Medium (Perception, Representation, Storage, Transmission.), Interaction Techniques.	**8**	**CO5**
		Self-learning Topics: -Study the objects and elements of multimedia.	**8**	
VI	**Digital Image, audio & video**	Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), File formats: JPG. Compression Techniques: fundamentals (coding, inter pixel and psychovisual redundancies). Types – lossless and lossy Compression, Lossless Compression Algorithms– Shannon-Fano, Lossy Compression Algorithm – JPEG **Digital Audio** Basic Sound Concepts: computer representation of sound. File Formats – WAV **Digital Video** Basics of Digital Video, Digitization of Video, **File Formats**: MPEG Video.	**8**	**CO6**

		Self-learning Topics: -Implementation of compression algorithms, Analysis of Digital audio and digital video file formats.	**8**	

Text Books:

1 Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication.
2 James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication
3 Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.
4 Multimedia System Design, Prabhat K. Andleigh& Kiran Thakrar, PHI
5 Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

References:

1 D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications.
2 Samit Bhattacharya, "Computer Graphics", Oxford Publication
3 Multimedia Communication Systems: Techniques, Standards & Networks, K. R. Rao, Zoran S. Bojkovic & Dragorad A. Milovanovic, TMH.
4 Multimedia Systems, K. Buford, PHI.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/106/106106090/
2.	https://nptel.ac.in/courses/106/103/106103224/
3.	https://nptel.ac.in/courses/106/102/106102065/
4.	https://onlinecourses.swayam2.ac.in/nou21_cs04/preview
5.	https://nptel.ac.in/courses/117/105/117105083/

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.

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	
26152215702	Distributed Computing	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					
26152215702	Distributed Computing	20	20	40	60	2.5	--	--	100

Rationale :

With the rapid growth of networked and cloud-based systems, distributed computing has become a fundamental part of modern computing infrastructure. This course provides students with essential knowledge of distributed system architecture, communication mechanisms, synchronization, and resource management. It enables learners to understand how large-scale systems such as cloud platforms and distributed databases operate efficiently and reliably. The course also focuses on fault tolerance, security, and real-world applications, preparing students to design and develop scalable and robust distributed applications for industry needs.

Course Objectives

1 To understand the fundamental concepts and architecture of distributed systems.
2 To learn communication models, protocols, and service interaction mechanisms used in distributed systems.
3 To understand synchronization, coordination, and consensus techniques for managing distributed processes and resources.
4 To study resource management and scheduling in distributed systems.
5 To explore distributed file systems, databases, and consistency models.
6 To understand fault tolerance and security issues in distributed computing.

Course Outcomes

1. Explain and understand the concepts and architecture of distributed systems. (L1, L2)
2. Apply and demonstrate communication and synchronization techniques in distributed environments. (L3)
3. Analyze and examine distributed algorithms and resource management strategies. (L4)
4. Evaluate and compare distributed file systems and database management techniques (L4, L5)
5. Analyze and evaluate fault tolerance and security mechanisms in distributed systems.(L4, L5)
6. Design and develop basic distributed applications and solutions. (L5, L6)

Prerequisite: Operating System, Computer Networks, Data Structures, DBMS

DETAILED SYLLABUS:

Module	Module	Detailed Contents of Module	Hrs.	COs
0	**Prerequisite**	Basic knowledge of Operating Systems and Computer Networks is required. Basic programming concepts, Data structures, and fundamentals of DBMS and concurrency.		
I	**Introduction to Distributed System**	Introduction and evolution of Distributed Computing and its need., Characteristics of distributed systems: resource sharing, scalability, concurrency, transparency. Goals and challenges: heterogeneity, openness, security, fault tolerance. Types of distributed systems: cluster computing, grid computing, cloud computing. Distributed system architectures: client–server architecture, Peer-to-peer and multi-tier architectures. Middleware concepts, role of middleware and examples.	**7**	**CO1**
		Self-Learning Topics: Comparison of cluster, grid, and cloud computing, Middleware technologies in Distributed Computing	**7**	
II	**Communica-tion in Distributed Systems**	Interprocess communication, message passing models, sockets, Remote Procedure Call (RPC), Remote Method Invocation (RMI), group communication, middleware platforms, REST-based communication and service-oriented architecture.	**8**	**CO2**
		Self-Learning Topics: REST vs SOAP communication models in Distributed Systems, Practical use of RPC and RMI frameworks.	**8**	
III	**Synchronizatio n and**	Introduction to synchronization in Distributed Systems and need for clock synchronization, Physical clocks and clock synchronization techniques, Logical clocks and Lamport timestamps, Vector clocks and their applications, Distributed	**8**	**CO3**

	Coordination	mutual exclusion algorithms: Lamport and Ricart–Agrawala, Leader election algorithms in distributed systems, Distributed deadlock detection and basic consensus algorithms.		
		Self-Learning Topics: Comparison of logical clocks and vector clocks in Distributed Systems, Applications of consensus algorithms	**8**	
IV	**Resource management and scheduling**	Resource management and need for scheduling in Distributed Systems, Distributed scheduling techniques, Load balancing techniques, Load sharing algorithms, Task allocation strategies, Process migration and thread management, Virtualization concepts in distributed computing.	**7**	**CO4**
		Self-Learning Topics: Load balancing in cloud environments in Distributed Systems, Role of virtualization in distributed computing	**7**	
V	**Distributed File Systems and Databases**	Architecture of Distributed File Systems, File service models, Consistency models in distributed systems, Data-centric consistency models, Client-centric consistency models, Replication strategies, Distributed databases and transaction management, Case studies: Network File System and Google File System.	**8**	**CO5**
		Self-Learning Topics: Comparison of consistency models in Distributed Systems, Working of Google File System and modern distributed storage systems	**8**	
VI	**Fault Tolerance and Security**	Types of failures in Distributed Systems, Fault tolerance techniques, Check pointing and recovery mechanisms, Replication techniques for reliability, Secure communication in distributed systems, Authentication and security challenges in distributed environments, Distributed platforms such as Cloud Computing.	**7**	**CO6**
		Self Learning Topics: Security challenges in Distributed Systems, Fault tolerance in cloud-based distributed platforms	**7**	

Text Books

1 Distributed Systems: Concepts and Design – George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Pearson Education.

2 Distributed Systems: Principles and Paradigms – Andrew S. Tanenbaum and Maarten Van Steen, Pearson.
3 Distributed Computing – Oxford University Press.

Reference Books

1 Distributed Systems – Maarten Van Steen and Andrew S. Tanenbaum.
2 Distributed Computing: Principles, Algorithms and Systems – Ajay D. Kshemkalyani and Mukesh Singhal.
3 Distributed Systems: An Algorithmic Approach – Sukumar Ghosh.

Digital Links / Online Resources

1.	NPTEL – Distributed Systems course lectures.
2.	MIT OpenCourseWare – Distributed Systems course materials.
3.	Coursera – Distributed Systems and Cloud Computing courses.
4.	edX – Distributed Computing and Cloud Systems courses.
5.	Apache Hadoop documentation and tutorials.

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	
26152215703	Advance Data Management Technologies	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					
26152215703	Advance Data Management Technologies	20	20	40	60	2.5	--	--	100

Rationale:

With the rapid growth of digital technologies, large volumes of data are generated, stored, and processed by organizations across various sectors. Efficient management, storage, and analysis of this data have become essential for supporting decision making and building data-driven applications. This course provides students with knowledge of advanced database concepts such as query processing and optimization, distributed databases, data warehousing, ETL processes, and modern data management technologies including Big Data and NoSQL databases. It enables learners to understand how large-scale data systems are designed and managed in real-world environments and prepares them to develop efficient, scalable, and secure data management solutions for modern enterprises.

Course Objectives:

1. To understand the concepts of query processing and query optimization in a Database

Management System.
2. To learn advanced database management techniques including access control mechanisms and emerging database models such as temporal, mobile, and spatial databases.
3. To understand the architecture, design issues, and concepts of distributed database systems.
4. To understand how organizations manage and analyze large volumes of data using data warehousing, dimensional modeling, and business intelligence techniques.
5. To understand the ETL (Extract, Transform, Load) process used in data integration and data warehousing systems.
6. To gain basic knowledge of modern data management technologies such as Big Data and NoSQL databases.

Course Outcomes:

1. Describe the concepts of query processing, query cost evaluation, and query optimization techniques used in database management systems. (L1)
2. Identify advanced database management techniques including access control mechanisms, database security models, and emerging database models such as mobile, temporal, and spatial databases. (L1, L2)
3. Recognize the architecture, design issues, data fragmentation, and data allocation techniques used in distributed database systems. (L1, L2)
4. Apply data warehousing concepts, dimensional modeling techniques, and business intelligence approaches to organize and manage enterprise data effectively. (L1, L2, L3)
5. Illustrate the role of ETL processes and OLAP operations in data integration, data analysis, and decision support systems. (L1, L2)
6. Implement modern data management solutions using Big Data concepts and NoSQL database technologies for large-scale data applications. (L1, L2, L3)

Prerequisite: Reviewing basic concepts of a Relational database, SQL concepts

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Query Processing and Optimization in DBMS**	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression, Estimating Statistics of Expression	**07**	**CO1**

		Results Choice of Evaluation Plans.		
		Self-learning Topics: **Case Study: Improving the Performance of an Online Shopping Database** Identify slow SQL queries and suggest simple optimization techniques such as indexing, selection pushdown, and query rewriting to improve performance. **Case Study: Analyzing Query Processing in a Library Management System** Study how common queries (book search, issue/return records, student-wise book history) are processed and discuss how different execution plans can affect query performance.	**07**	
II	**Advanced Data Management and Security Techniques**	Advanced Database Access Protocols: Discretionary Access Control based on granting and revoking privileges, Mandatory Access Control and Role-Based Access Control (RBAC), and Remote Database Access Protocols. Advanced Database Models: Overview of advanced database models such as Mobile Databases, Temporal Databases, and Spatial Databases, along with an introduction to Distributed Databases and Cloud Databases.	**08**	**CO2**
		Self-Learning Topics: Study data security concepts such as Authentication, Authorization, and Encryption, and explore the basic concepts of Database Privacy and Data Protection. Learn about common database security threats such as SQL Injection, data breaches, and unauthorized access. Explore basic techniques for database backup and recovery and study simple case studies related to data security practices used in organizations to protect sensitive data.	**08**	

III	**Distributed Databases**	Introduction: Distributed Data Processing, Distributed Database Systems: Architecture, Types of Distributed Databases, and Design Issues in Distributed Databases. Distributed Database Design: Data Fragmentation (Horizontal, Vertical, and Hybrid), Data Allocation in Distributed Databases, Data Replication Techniques, and Distributed Query Processing. Transaction Management: Transaction Management in Distributed Databases, Basic Concepts of Data Consistency and Concurrency Control in Distributed Environments.	**07**	**CO3**
		Self-learning Topics: Study query optimization techniques used in distributed databases and understand the basic concepts of the CAP Theorem in distributed systems. Explore how distributed databases manage data consistency, availability, and partition tolerance in large-scale environments. Perform a case study on distributed database applications used in large organizations or cloud-based platforms, focusing on how distributed data storage and processing improve system scalability and reliability.	**07**	
IV	**Data Warehousing and Business Intelligence**	Data Warehousing: Need for Data Warehousing, Definition of Data Warehouse, Relevance of Data Warehousing in the age of Big Data, Features of a Data Warehouse. Data Warehouse Architecture – Enterprise/Centralized, Federated and Multi-tier Architectures. Data Warehouse and Data Marts, Data Warehousing Design Strategies. Dimensional Modelling: Dimensional Data Model, Star Schema, Snowflake Schema, Fact Tables and Dimension Tables, Factless Fact Tables, Updates to Dimension Tables, Primary Keys, Surrogate Keys and Foreign Keys, and basic query execution in dimensional models.	**08**	**CO4**

		Business Intelligence and OLAP: Introduction to Business Intelligence (BI), Uses of BI, Tools used in BI. Need for Online Analytical Processing (OLAP). OLAP Operations in a Cube – Roll-up, Drill-down, Slice, Dice, and Pivot. OLAP Architectures – MOLAP, ROLAP, DOLAP and HOLAP.		
		Self-learning Topics: Explore the life cycle of Data Warehouse development, including stages such as requirement analysis, data collection, data integration, ETL processing, data storage, and reporting. Study how organizations plan, design, and implement data warehouse systems for effective decision support. Conduct a case study on a real-world data warehouse application (such as in banking, retail, or healthcare sectors) and analyze how data from multiple sources is integrated and used for business intelligence and strategic decision making.	**08**	
V	**ETL Process and Data Integration**	ETL Process: Introduction to ETL (Extract, Transform, Load) Process, Challenges in ETL Functions, Data Extraction and Identification of Data Sources, Immediate Data Extraction and Deferred Data Extraction. Data Transformation and Loading: Tasks involved in Data Transformation, Techniques of Data Transformation, and Techniques of Data Loading in Data Warehousing systems.	**07**	**CO5**
		Self-learning Topics: Explore various ETL tools used for enterprise data management and perform a case study on ETL processes used in data warehousing projects, focusing on how data is extracted from multiple sources, transformed for analysis, and loaded into a data warehouse for business intelligence applications.	**07**	
VI	**Big data and NoSQL**	Big Data: Introduction to Big Data, Types and Characteristics of Big Data. NoSQL Databases: Introduction to NoSQL, CAP	**08**	**CO6**

		Theorem, BASE Properties. NoSQL Data Architecture Patterns: Key–Value Stores, Column Family Stores, Document Stores, and Graph Databases.		
		Self-learning Topics: Explore the working of popular NoSQL databases such as Google Bigtable, Apache Cassandra, MongoDB, and Neo4j. Perform a case study on the use of NoSQL databases in large-scale applications, such as handling large datasets, real-time data processing, and social network data management.	**08**	

Textbooks:

1. Korth, Slberchatz, Sudarshan, :"Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Theraja Reema, "Data Warehousing", Oxford University Press.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition. Wiley India.
3. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
4. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 9th Edition.

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	
26152215704	Principles of Analog and Digital Communication	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					
26152215704	Principles of Analog and Digital Communic-ation	20	20	40	60	2.5	--	--	100

Rationale:

The subject **Principles of Analog and Digital Communication** helps students understand how information is transmitted using analog and digital systems. It covers modulation, noise, sampling, and multiplexing, which are essential for modern communication technologies like mobile phones, TV, and the internet.

Course Objectives:

1 Study the basics of Communication Systems and noise.
2 Acquire the knowledge of analog modulation technique AM and study the block diagram of transmitter and receiver.
3 Acquire the knowledge of analog modulation technique FM and study the block diagram of transmitter and receiver.
4 Study the Sampling theorem and Pulse Analog and digital modulation techniques
5 Learn the concept of multiplexing and digital band pass modulation techniques
6 Gain the core idea of electromagnetic radiation and propagation of waves.

Course Outcomes:

1. Explain analog, digital communication systems and types of noise. (L1, L2)
2. Describe transmission and reception of AM. (L1, L2, L3)
4 Describe transmission and reception of FM, (L1, L2, L3)
5 Explain Sampling theorem and pulse modulation systems. (L1, L2, L3)
6 Explain multiplexing and digital band pass modulation techniques. (L1, L2)
7 Describe electromagnetic radiation and propagation of waves. (L1, L2**)**

Prerequisite: Basic of electrical engineering.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to communication systems and noise**	Basics of analog communication and digital communication systems (Block diagram), Types of Communication channels. Introduction to Fourier Transform, its properties. Types of Noise, Noise parameters –Signal to noise ratio, Noise factor, Noise figure, Friss formula and Equivalent noise temperature	**08**	**CO1**
		Self-learning Topics: Applications areas of analog and digital communication. Signal Representation & Classification Energy vs power signals, Periodic vs non-periodic signals, Even and odd signals. Deterministic vs random signals, Bandwidth Concepts	**08**	
II	**Amplitude modulation Techniques.**	**AM**: Need for modulation, Amplitude Modulation Techniques: DSBFC AM, DSBSC-AM, SSB SC AM- block diagram, spectrum, waveforms, bandwidth, Power calculations. **AM Generation**: AM generation using Diode, generation of DSB using Balanced modulator, Generation of SSB using Phase Shift Method. AM Transmitter (Block Diagram) AM Receivers – Block diagram of TRF receivers and Super heterodyne receiver and its characteristics- **AM Receiver characteristics:** Sensitivity, Selectivity, Fidelity, Image frequency and its rejection and double spotting	**08**	**CO2**

		Self-learning Topics: Efficiency of AM Systems, Implementation complexity **Real-World Applications of AM** Radio broadcasting Aviation communication Shortwave transmission	**08**	
III	**Frequency Modulation Techniques**	**FM:** Principle of FM- waveforms, spectrum, bandwidth. Pre- emphasis and de-emphasis in FM, FM generation: Direct method –Varactor diode Modulator, Indirect method (Armstrong method) block diagram and waveforms. FM demodulator: Foster Seeley discriminator, Ratio detector.	**08**	**CO3**
		Self-learning Topics: Use FM in Modern Communication Technology. Challenges faced by radio business. Applications of FM Communication: FM radio broadcasting TV sound transmission Two-way radio systems (walkie-talkies)	**08**	
IV	**Pulse Analog Modulation and Digital Modulation**	Sampling theorem for low pass and band pass signals, Anti- aliasing filter, PAM, PWM and PPM generation And Degeneration. Quantization process, Pulse code modulation, Delta modulation, Adaptive delta modulation.	**07**	**CO4**
		Self-learning Topics: Introduction to Line Codes, ISI and EYE diagram. **Pulse Modulation in Communication Systems.** Applications of PAM, PWM, and PPM Use in telemetry and control systems	**07**	
V	**Multiplexing and Band Pass Modulation Techniques**	Principle of Time Division Multiplexing, Frequency Division Multiplexing, Orthogonal Frequency Division Multiplexing and its applications ASK, FSK, PSK	**07**	**CO5**
		Self-learning Topics: Multiplexing in communication systems. QPSK Generation and detection. Use of shift keying techniques in communication	**07**	

VI	**Radiation and Propagation of Waves**	Electromagnetic radiation, fundamentals, types of propagation, ground wave, sky wave, space wave tropospheric scatter propagation. Introduction to wireless communication.	**07**	**CO6**
		Self-learning Topics: Application of Electromagnetic spectrum in service sector and mobile communication	**07**	

Text Books:

[1]. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed

[2]. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.

[3]. Wireless Communication and Networking, Vijay Garg

References:

[1]. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.

[2]. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University

[3]. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata McGraw Hill, 3rdEd.

[4]. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.classcentral.com
3.	http://www.vlab.co.in/

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	
26152215705	Green IT	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					
26152215705	Green IT	20	20	40	60	2.5	--	--	100

Rationale:

Most of the engineering branches are off-spring **of** Information Technology and related fields, which increasingly rely on computers, networks, software, and data centers. With the rapid growth of IT, energy consumption, electronic waste, and carbon footprint have become major environmental concerns. This course on Green IT introduces students to the principles, strategies, and practices of sustainable computing. It equips learners with the knowledge **to** design energy-efficient software, implement green data centers, adopt green networking and cloud computing solutions, and leverage AI/ML for sustainability**,** enabling them to contribute to environmentally responsible IT solutions and promote sustainability in their professional practice.

Course Objectives:

1. To understand the concepts and fundamentals of Green IT, including environmental impacts, green hardware, software, and enterprise strategies.
2. To learn sustainable software practices, green data centers, energy-efficient storage, and methods to measure sustainability metrics.
3. To understand green networking, cloud computing, and how ICT infrastructure can be made energy-efficient.

4. To learn the development and implementation of Green IT strategies, sustainable IT services, and organizational sustainability frameworks.
5. To explore semantic web technologies, environmental data management, and green initiatives, and industry standards.
6. To study the implementation of Green IT in communication, social media, smart grids, AI/ML applications, smart cities, and future sustainable technologies.

Course Outcomes:

1. Describe the fundamentals of Green IT, including environmental impacts, green hardware and software, eco-labeling, and enterprise strategies. (L1)
2. Identify sustainable software practices, green data centers, energy-efficient storage systems, and methods to measure software and data center sustainability metrics. (L1, L2)
3. Recognize objectives of green network protocols, green cloud computing, and strategies for energy-efficient ICT infrastructure. (L1, L2)
4. Apply Green IT strategies, sustainability hierarchy models, capability maturity frameworks, and sustainable IT services for organizational and enterprise greening. L1, L2, L3)
5. Illustrate environmental sustainability initiatives using semantic web technologies, green cloud services, green building standards, NGO initiatives, and green ICT tools. (L1, L2)
6. Implement Green IT in practical scenarios, including AI/ML applications for sustainability, smart cities, smart grids, RFID-based environmental monitoring, green supply chain management, and enterprise sustainability strategies. (L1, L2, L3)

Prerequisite: Environmental Studies

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Green IT and Green Devices**	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy, Green IT: Burden or Opportunity? Green device or Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose Green Software: Introduction, Energy-Saving Software Techniques	**7**	**CO1**
		Self-learning Topics: Evaluating and Measuring Software Impact to Platform Power, Environmental Concerns and Sustainable Development	**7**	
II	**Sustainable Software and**	Sustainable Software, Software Sustainability Attributes and Metrics Green Data center: Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, Green Data Centre Metrics	**8**	**CO2**

	Green Data Centers	Green Data Storage: Introduction, Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management		
		Self-learning Topics: Sustainable Software Methodology, Sustainable Software: A Case Study, Data Centre Management Strategies: A Case Study, **Case Study:** Green Computing Initiatives in Google Data Centers	**8**	
III	**Green Networking and Green Cloud Computing**	Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards Green Cloud Computing: What is Cloud Computing, Cloud Computing and Energy Usage Model, Features of Clouds Enabling Green Computing, Towards Energy Efficiency of Cloud Computing, Green Cloud Architecture	**7**	**CO3**
		Self-learning Topics: System-Level Energy Management**,** Case Study: IaaS Provider, **Case Study:** Green Cloud Infrastructure of Amazon Web Services, System-Level Energy Management in Computer Networks	**7**	
IV	**Green IT Strategies and Sustainable IT Services**	Approaching Green IT Strategies, Business Drivers of Green IT Strategy Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, , Measuring the Maturity of Sustainable ICT: A Capability Maturity Framework for SICT. Background: Readiness and Capability Development of the G-Readiness. Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework Organizational and Enterprise Greening, Sustainable IT Roadmap Developing a City Sustainability Plan: A Case Study	**8**	**CO4**
		Self-learning Topics: Individual and Functional Level Information, Business Dimensions for Green IT Transformation, Metrics and Measurements in Green Strategies, Framework, Measuring an Organization's G-Readiness, SITS Leadership and Best Practices	**8**	
		Semantic Web Technologies: Information Management for Environmental Sustainability, Ecosystem of Software Tools, Examples of Managing Data, Challenges and Guiding Principles.	**7**	**CO5**

V	**Environmental Sustainability through Semantic Web and Green Initiatives**	Strategizing Green Initiatives, Implementation of Green IT, Industry Associations and Standards Bodies, Green Building Standards, Social Movements and Greenpeace		
		Self-learning Topics: Role of NGOs in Environmental Sustainability, Information Assurance, Green Data Centers, Case Study: Managing Green IT, environmental Data Management Tools, Green Cloud Services and Web Applications – Energy-efficient web hosting and cloud resource management.	**7**	
VI	**Implementation of Green IT and Future Trends**	Communication and social media The Regulatory Environment and IT Manufacturers, non-regulatory Government Initiatives, Role of AI and ML in Environmental Sustainability, AI Techniques for Sustainable Development, Challenges of Using AI in Environmental Applications Awareness to Implementation, Greening by IT - Using RFID for Environmental Sustainability, Smart Grids, Smart Buildings and Homes, Green Supply Chain and Logistics, Enterprise-Wide Environmental Sustainability,AI in Smart Cities for Sustainable DevelopmenT, Machine Learning for Energy Consumption Optimization**.**AI for Climate Change Prediction and Analysis Green IT: A Megatrend? A Seven-Step Approach to Creating Green IT Strategy, Research and Development Directions	**8**	**CO6**
		Self-learning Topics: Environmental Data Sources and Data Analytics, AI and ML in Green IT Web Applications **–** Predictive analytics for carbon footprint reduction. Big Data for Environmental Monitoring, AI-Based Decision Support Systems for Sustainability	**8**	

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2013
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach, Elsevier 2015 3.
3. Reinhold, Carol Baroudi, and Jeffrey HillGreen IT for Dummies, Wiley 2009

References:

1. Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS

2. Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen the Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Online References:

Sr. No.	Website Name
1.	**Microsoft Sustainability** – https://www.microsoft.com/en-us/sustainability Learn about Microsoft's green data center initiatives and cloud energy efficiency.
2.	**Smart Cities Council** – https://smartcitiescouncil.com/ Sustainable infrastructure, green IT, smart grids, and urban sustainability projects.
3.	**coursera: Green IT & Sustainability Courses** – https://www.coursera.org Offers courses like "Green Computing," "Sustainable IT" and "AI for Earth."
4.	**Springer and ResearchGate** – https://www.springer.com/ & https://www.researchgate.net/ Research papers on Green IT, sustainable software, and AI/ML applications in sustainability.
5.	**Green IT Amsterdam** – https://www.greenitamsterdam.com/ Insights on Green IT trends, case studies, and enterprise sustainability strategies.
6.	**UN Environment Programme – ICT for Environment** – https://www.unep.org/resources Global perspective on ICT and environmental sustainability initiatives.

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	
2615412509	MAD & PWA 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					
2615412509	MAD & PWA Lab	--	--	--	--	--	25	--	25

Lab Objectives:

1. Learn the basics of the Flutter framework.
2. Develop the App UI by incorporating widgets, layouts, gestures and animation
3. Create a production ready Flutter App by including files and firebase backend service.
4. Learn the Essential technologies, and Concepts of PWAs to get started as quickly and efficiently as possible
5. Develop responsive web applications by combining AJAX development techniques with the jQuery JavaScript library.
6. Understand how service workers operate and also learn to Test and Deploy PWA.

Lab Outcomes:

1. Understand cross platform mobile application development using Flutter framework. (L1, L2)
2. Design and Develop interactive Flutter App by using widgets, layouts, gestures and animation. (L3)
3. Analyze and Build production ready Flutter App by incorporating backend services and deploying on Android / iOS (L3, L4)
4. Understand various PWA frameworks and their requirements. (L1, L2)
5. Design and develop a responsive User Interface by applying PWA Design techniques (L3)
6. Develop and Analyze PWA Features and deploy it over app hosting solutions (L3,L4)

Prerequisite: HTML/HTML5, CSS3, JavaScript

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	JDK 8 and above, Android studio, Flutter SDK, AngularJs, React, Vue, PWA Builder, Google Chrome Browser, Github account. Internet Connection.

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
I	**Basics of Flutter Programming**	Introduction of Flutter, Understanding Widget Lifecycle Events, Dart Basics, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App.	**02**	**LO1**
II	**Developing Flutter UI: Widgets, Layouts, Gestures, Animation,** **AI Voice Assistant**	**USING COMMON WIDGETS:** SafeArea, Appbar, Column, Row, Container, Buttons, Text, Richtext, Form, Images and Icon. **BUILDING LAYOUTS**: high level view of layouts, Creating the layout, Types of layout widgets. **APPLYING GESTURES:** Setting Up Gesture Detector, Implementing the Draggable and Drag Target Widgets, Using the Gesture Detector for Moving and Scaling **ADDING ANIMATION TO AN APP**: Using Animated Container, using Animated CrossFade, Using Animated Opacity, Using Animation Controller, Using Staggered Animation **CREATING AN APP'S NAVIGATION USING AI VOICE ASSISTANT:** Using the Navigator, Using the Named Navigator Route, Using the Bottom	**06**	**LO2**

		Navigation Bar, Using the TabBar and TabBar View, Voice Simulation Using AI		
III	**Creating Production Ready Apps Using AI Personalization**	**Working with files:** Including libraries in your Flutter app, including a file with your app, Reading/Writing to files, Using JSON. **Using Firebase with Flutter:** Adding the Firebase and Firestore Backend, Configuring the Firebase Project, adding a Cloud Firestore Database and Implementing Security **Testing and Deploying of Flutter Application Using AI Personalization:** Widget testing, Deploying Flutter Apps on Android / iOS	**04**	**LO3**
IV	**Introduction to Progressive Web App**	Introduction to Progressive Web App • Why Progressive Web App • Characteristics of PWA • PWAs and Hybrid Apps vs. Mobile Apps • PWA Requirements: HTTPS, Service Workers, and Web App Manifest • PWA framework tools Use cases	**02**	**LO4**
V	**Creating Responsive UI**	**Creating Responsive UI using JQuery Mobile / Material UI / Angular UI / React UI** • Understanding the concept of responsive web design • Comparing responsive, fluid, and adaptive web • keys to great Progressive Web App UX • Responsive Design – The Technicalities • Flexible grid-based layout • Flexible images and video Smart use of CSS splitting the website behavior (media queries)	**06**	**LO5**
		Web App Manifest: Understand the basic format and workings of the Web App Manifest file. • Using an App Manifest to Make your App Installable. • Understanding App Manifest Properties. • Simulating the Web App on an Emulator. • Installing the Web App – Prerequisites. • Understanding manifest.json		

VI	**Web App Manifest & Service Workers**	**Service Workers:** Making PWAs work offline with Service workers • Introduction to Service Workers • Service Workers Lifecycle (Registration, Installation and Activation) • Implement Service Workers Features (Events) • Handling cached content • Enabling offline functionality • Serving push notifications • Loading cached content for new users • Background synchronization • Using IndexedDB in the Service Worker • Geo-fencing Deploy a PWA to GitHub Pages as a free SSL enabled static app hosting solution. • Initializing the PWA as a Git repo • Testing with Lighthouse Deploying via GitHub Pages **Deploy a PWA to GitHub Pages as a free** **SSL enabled static app hosting solution.** • Initializing the PWA as a Git repo • Testing with Lighthouse • Deploying via GitHub Pages	**06**	**LO6**

Text Books:

1 Beginning Flutter, a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020.
2 Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019
3 Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web, Packt Publishing Limited ,2018
4 Building Progressive Web Apps,O'Reilly 2017.
5 Progressive Web Apps with Angular: Create Responsive, Fast and Reliable PWAs Using Angular, Apress; 1st ed. edition (28 May 2019).
6 AI Engineering: Building Applications with Foundation Models, Chip Huyen, O'Reilly (Updated 2026).
7 AI and Machine Learning For Coders: A Programmer's Guide to Artificial Intelligence, Laurence Moroney, O'Reilly.

References:

1 Flutter in Action by Eric Windmill, MANING, 2019.

2 Google Flutter Mobile Development Quick Start Guide.Packt,2019.
3 Learning Progressive Web Apps: Building Modern Web Apps Using Service Workers, Addison- Wesley Professional, 2020.
4 Google Developers - Flutter AI Toolkit: A comprehensive resource for integrating AI chat-related widgets and multimodal models like Gemini into Flutter apps.
5 Firebase Documentation for Vertex AI.
6 Alan AI Platform Documentation.

Online References:

Sr. No.	Website/Reference link
1.	https://flutter.dev/docs/reference/tutorials
2.	https://www.tutorialspoint.com/flutter/index.html
3.	https://www.javatpoint.com/flutter
4.	https://www.tutorialspoint.com/jquery_mobile/jqm_panel_responsive.html
5.	https://www.w3schools.com/css/css_rwd_intro.asp
6	https://developers.google.com/web/updates/2015/12/getting-started-pwa
7	https://www.w3schools.com/react/
8	https://angular.io/docs
9	https://flaviocopes.com/service-workers/
10	https://blog.logrocket.com/how-to-build-a-progressive-web-app-pwa-with-node-js/
11	Voice AI Assistant App Tutorial - YouTube
12	Official Pub.dev Package
13	alan_voice | Flutter Package
14	Integrating Generative AI with Firebase Vertex AI
15	Flutter CRM & AI Agent Template

Suggested List of Experiments

Sr. No.	Experiment Title
1	To install and configure Flutter Environment.
2	To design Flutter UI by including common widgets.
3	To create an interactive Form using form widget.
4	To design a layout of Flutter App using layout widgets
5	To include icons, images, charts in Flutter app.
6	Applying Navigation, Routing, and Gesture Control via Voice Assistant Integration.
7	To Connect Flutter UI with fireBase database
8	To test and deploy production ready Flutter App on Android platform
9	Designing a Responsive E-commerce UI with AI-powered User Personalization.
10	To write meta data of your Ecommerce PWA in a Web app manifest file to enable “add to home screen feature”.
11	To code and register a service worker, and complete the install and activation process for a new service worker for the E-commerce PWA
12	To implement Service worker events like fetch, sync and push for E-commerce PWA.
13	To study and implement deployment of Ecommerce PWA to GitHub Pages.
14	To use google Lighthouse PWA Analysis Tool to test the PWA functioning.
15	To deploy an Ecommerce PWA using SSL enabled static hosting solution.

Assignment 1: MAD (Any one)

1 To Study basics of Dart language and design basic Flutter App
2 To include Files and JSON data in App
3 To build interactive App by including Flutter Gestures and Animations
4 Design a workflow for an ai-powered user personalization engine for an e-commerce pwa. how would you use data from firestore (e.g., past purchase history) to dynamically re-rank product cards on the home screen?

Assignment 2: PWA (Any one)

To study the requirement for progressive web application for Ecommerce using the concept of service worker, Webapp Manifest and framework tools.
To Design a wireframe for simple PWA for E-commerce website.
Design Case study for successful real-life implementation of PWA.
Compare on-device Speech-to-Text (STT) vs. Cloud-based STT for implementing a Voice Assistant. Which approach would you choose for a low-bandwidth user in a rural area, and why?
Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term Work Journal must include at least 2 assignments as mentioned in above syllabus.

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

T.Y. B. Tech Syllabus 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	
2615211601	AI and DS - 1	3	--	--	45	-	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT II	Total					
2615211601	AI and DS - 1	20	20	40	60	2.5	--	--	100

Rationale:

With the rapid advancement of digital technologies, vast amounts of data are generated every day from various sources such as social media, sensors, business transactions, and online platforms. Extracting meaningful insights from this data has become essential for organizations to support intelligent decision making and develop smart applications. This course on Artificial Intelligence and Data Science introduces students to the fundamental concepts of data analysis, machine learning, and intelligent systems. It provides knowledge of data preprocessing, predictive modeling, and data-driven decision-making techniques using modern tools and algorithms. The course enables learners to understand how intelligent systems analyze data, recognize patterns, and automate complex tasks, preparing them to develop innovative AI-enabled and data-driven solutions for real-world applications

Course Objectives

1. To understand the fundamental concepts of Artificial Intelligence, including AI techniques, problem formulation, and intelligent agents.
2. To learn different AI search techniques and algorithms used for problem solving in intelligent systems.
3. To understand knowledge representation and reasoning methods used in Artificial Intelligence for decision making.
4. To introduce the concepts of Data Science and Exploratory Data Analysis (EDA) for analyzing and interpreting data.
5. To study the fundamentals of Machine Learning, including supervised and unsupervised learning algorithms and model evaluation techniques.
6. To understand the principles of Reinforcement Learning and Expert Systems and their applications in intelligent systems.

Course Outcomes

1. 1.Describe the fundamental concepts of Artificial Intelligence, intelligent agents, and generative AI technologies. (L1)
2. Identify and apply different AI search techniques and algorithms for solving problem-solving tasks. (L1, L2)
3. 3.Explain knowledge representation and reasoning techniques used in Artificial Intelligence systems. (L1, L2)
4. Apply Data Science and Exploratory Data Analysis techniques to analyze and interpret datasets. (L2, L3)
5. 5.Implement Machine Learning algorithms for classification, regression, clustering, and dimensionality reduction. (L2, L3)
6. 6.sExplain the concepts of Reinforcement Learning and Expert Systems and analyze their applications in real-world intelligent systems. (L1, L2, L3)

Prerequisite: Programming Basics, Statistics Basics

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to AI**	**Introduction:** Definition of Artificial Intelligence, AI techniques, Problem Formulation. Goals and objectives of AI, History and evolution of AI, Importance of AI in modern technology, Difference between AI, Machine Learning, and Data Science **Intelligent Agents:** Definition of an intelligent agent, Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. **Generative AI:** Introduction to Gen- AI and Types of Generative Models.	**07**	**CO1**
		Self-Learning Topics: Explore different **application areas of Artificial Intelligence** in sectors such as healthcare, education, finance, transportation, agriculture, and e-commerce. Study real-world examples where AI is used for **automation, recommendation systems, image recognition, and predictive analysis**. Conduct a **case study on the application of AI in a real-world system**, such as voice assistants, chatbots, or recommendation engines, and analyze how AI techniques are used to solve practical problems. You may explore examples like **ChatGPT**, **Google Assistant**, or **Amazon Alexa** to understand how	**07**	

		intelligent agents and AI technologies are applied in everyday applications.		
II	**Search Techniques**	**Uninformed Search Techniques:** BFS, DFS, Uniform cost search, Depth Limited Search, Iterative Deepening, Bidirectional search. **Informed Search Methods:** Heuristic functions, Best First Search, A*,Local Search Techniques: Hill Climbing, Genetic Algorithm. **Adversarial Search Problem Solving:** Water Jug, Min-Max Search, Alpha Beta Pruning. Comparing Different Techniques.	**08**	**CO2**
		Self-Learning Topics: Study the working of different uninformed and informed search techniques and understand the role of heuristic functions in improving search efficiency. Practice solving simple AI problems such as the water jug problem and puzzle problems using different search strategies. Conduct a short case study on the use of search algorithms in real-world applications such as route finding and game playing. Explore how algorithms like A* Search Algorithm and Breadth-First Search are used in navigation systems such as Google Maps for finding optimal paths.	**08**	
III	**Knowledge Representation and Reasoning.**	**Knowledge:** Knowledge Representation, Types of Knowledge in AI, A Knowledge Based Agent, WUMPUS WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining, Resolution. Planning as an application of a knowledge based agent. **Reasoning**: Types of reasoning, Concepts of Partial Order planning.	**07**	**CO3**
		Self-Learning Topics: Explore different **knowledge representation techniques** used in Artificial Intelligence and study how knowledge-based systems support decision making. Practice solving simple problems using **propositional logic and predicate logic**. Conduct a **short case study on the use of knowledge-based systems in real-world applications**, such as expert systems used in healthcare or education. You may explore examples like **MYCIN** to understand how AI systems use knowledge and reasoning to assist in decision making.	**07**	

IV	**Introduction to DS and EDA**	**Introduction to DS:** DS and Evolution of Data Science, Data Science Vs. Business Analytics Vs. Big Data, Data Analytics, Lifecycle, Roles in Data Science Projects. **Introduction to exploratory data analysis:** EDA, Typical data formats. Types of EDA, Graphical/Non graphical Methods, Univariate/multivariate methods Correlation and covariance, Degree of freedom Statistical Methods for Evaluation including ANOVA.	**08**	
		Self-Learning Topics: Explore the **applications of Data Science in various industries** such as healthcare, finance, retail, and transportation. Study how organizations use data science techniques for **data analysis, prediction, and decision making**. Conduct a **short case study on the use of data science in real-world applications**, such as recommendation systems, fraud detection, or customer behavior analysis. You may explore platforms like **Netflix** or **Amazon** to understand how data science is used to analyze large datasets and provide personalized recommendations to users.	**08**	**CO4**
V	**Introduction to Machine Learning**	**Introduction to Machine Learning;** Importance and Applications of Machine Learning; Machine Learning Workflow; Types of Machine Learning. **Supervised Learning**; Concepts of Training and Testing Data; Classification and Regression Problems; Algorithms including Logistic Regression, Decision Tree, and Support Vector Machine; Model Evaluation Metrics; Confusion Matrix; Accuracy, Precision, Recall and F1 Score; Cross Validation; Issues in Machine Learning such as Overfitting, Under fitting and Data Quality; Applications of Machine Learning in real-world domains. **Unsupervised Learning**: K Means Clustering, Hierarchical Clustering, Expectation Maximization Algorithm for Clustering. Dimensionality reduction technique, Principal Component Analysis. **Application of Machine Learning**: Issues in Machine learning, Application of Machine Learning, Steps in developing a Machine Learning Application.	**07**	**CO5**
		Self-Learning Topics: Explore real-world		

		applications of Machine Learning in domains such as **healthcare, finance, e-commerce, and recommendation systems**. Study how machine learning models are used for **disease prediction, fraud detection, customer analysis, and personalized recommendations** Explore **real-world case studies of Machine Learning applications** in different domains such as healthcare, finance, retail, and social media. Study how machine learning techniques like clustering and dimensionality reduction are used for **customer segmentation, anomaly detection, and data pattern analysis**.	**07**	
VI	**Reinforcement Learning and Expert Systems**	**Introduction to Reinforcement Learning:** Basic concepts of Reinforcement Learning, Agent, Environment, State, Action, Reward, Policy and Value Function, Exploration vs Exploitation, Markov Decision Process (MDP), applications of Reinforcement Learning in robotics, gaming, and decision-making systems. **Reinforcement Learning Algorithms:** Temporal Difference Learning, Q-Learning algorithm, basic working mechanism, implementation concepts, and applications. **Expert Systems:** Introduction to Expert Systems, characteristics and components of Expert Systems, Knowledge Base, Inference Engine, Knowledge Representation techniques, rule-based expert systems. **Applications of Expert Systems:** Advantages and limitations of Expert Systems, real-world applications in healthcare, business decision support, and intelligent advisory systems.	**08**	**CO6**
		Study the applications of **Reinforcement Learning** in real-world systems such as robotics, game playing, and recommendation systems. Case Study: Use of Reinforcement Learning in game development and autonomous decision-making systems. Case Study: Application of Reinforcement Learning in robotics for navigation and path planning. Study different techniques used for **knowledge representation in Expert Systems**.	**08**	

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson

Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
3. Howard J. Seltman, Experimental Design and Analysis, Carnegie Mellon University, 2012/1.
4. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press.
5. Reinforcement learning : An introduction , by Richard S. Sutton and Andrew G. Barto

References:

1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
2. George Lugar, AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
3. Data Science & Big Data Analytics, 1st Edition, 2015, EMC Education Services, Wiley. ISBN: 978-1118876138
4. Tom M.Mitchell "Machine Learning" McGraw Hill
5. Richard I. Levin, David S. Rubin "Statistics for Management" Pearson
6. Vivek Belhekar, "Statistics for Psychology using R" SAG

Online References:

Sr. No.	Website/Reference link
1.	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs83/
2.	https://nptel.ac.in/courses/106/105/106105077/
3.	https://www.coursera.org/specializations/jhu-data-science
4.	https://www.coursera.org/learn/machine-learning
5.	https://www.udemy.com/course/statistics-for-data-science-and-business-analysis/

Assessment:

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	
2615211602	Cryptography Network Security	3	-	--	45	--	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
2615211602	Cryptography Network Security	20	20	40	60	2.5	--	--	100

Rational

With the increasing dependence on digital communication and internet-based services, ensuring the confidentiality, integrity, and authenticity of information has become a critical necessity. This course introduces the foundational principles, algorithms, and protocols that underpin modern Cryptography and Network Security. It enables students to understand how encryption mechanisms, authentication schemes, and secure communication protocols operate in real-world environments. The course also addresses contemporary challenges such as public key infrastructure, firewall design, and network threats, preparing students to apply cryptographic solutions and build secure systems in today's interconnected digital landscape.

Course Objectives:

1. The basic concepts of computer and Network Security
2. Various cryptographic algorithms including secret key management and different authentication techniques.
3. Different types of malicious Software and its effect on the security.
4. Various secure communication standards including IPsec, SSL/TLS and email.
5. The Network Management Security and Network Access Control techniques in Computer Security.
6. Different attacks on networks and infer the use of firewalls and security protocols.

Course Outcomes:

1. Explain the fundamentals concepts of computer security and network security. (L1, L2)
2. Identify the basic cryptographic techniques using classical and block encryption methods. (L1)
3. Study and describe the system security malicious software. (L1, L2)

4. Describe the Network layer security, Transport layer security and application layer security.(L1,L2)

5. Explain the need of network management security and illustrate the need for NAC. (L1, L2)
6. Identify the function of an IDS and firewall for the system security. (L1, L2, L3)

Prerequisite: Basic Concepts Of Computer Networks & Network Design, Operating System

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Network Security & cryptography**	Computer security and Network Security(Definition), CIA, Services, Mechanisms and attacks, The OSI security architecture, Network security model. Classical Encryption techniques (mono-alphabetic and poly- alphabetic substitution techniques: Vigenere cipher, playfair cipher, transposition techniques: keyed and keyless transposition ciphers).Introduction to steganography.	**8**	**CO1**
		Self-learning Topics: Study some more classical encryption techniques and solve more problems on all techniques. Homomorphic encryption in cloud computing	**8**	
II	**Cryptography : Key management, distribution and user authentication**	Block cipher modes of operation, Data Encryption Standard, Advanced Encryption Standard (AES). RC5 algorithm. **Public key cryptography:** RSA algorithm. Hashing Techniques: SHA256, SHA-512, HMAC and CMAC, Digital Signature Schemes – RSA, DSS. Remote user Authentication Protocols, Kerberos, Digital Certificate: X.509, PKI.	**8**	**CO2**
		Self-learning Topics: Study working of elliptical curve digital signature and its benefits over RSA digital signature	**8**	
III	**Malicious Software**	SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Key loggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie	**7**	**CO3**
		Self-learning Topics: Study the recent malicious software's and their effects	**7**	
IV	**IP Security, Transport level security and Email Security**	IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP), Transport level security: VPN. Need Web Security considerations, Secure Sockets Layer (SSL)Architecture, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH) Protocol Stack. Email Security: Secure Email S/MIME Screen reader support enabled.	**7**	**CO4**

		Self-learning Topics: : Study Gmail security and privacy from Gmail help, Explore how HTTPS works in real browsers (padlock icon, certificate details), Difference between SSL and TLS versions (SSL 3.0, TLS 1.2, TLS 1.3)	**7**	
V	**Network Management Security and Network Access Control**	Network Management Security: SNMPv3, NAC: Principle elements of NAC ,Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control	**8**	**CO5**
		Self-learning Topics: Explore any open source network management security tool (e.g., OpenNMS, Zabbix), Study SNMPv1 vs. SNMPv2 vs. SNMPv3 — key security improvements in each version	**8**	
VI	**System Security**	IDS, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls	**7**	**CO6**
		Self-learning Topics: Study firewall rules table, Comparison of hardware vs. software firewalls, Explore real-world IDS tools (e.g., Snort, Suricata)	**7**	

Textbooks:

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013.
2. Behrouz A. Ferouzan, “Cryptography & Network Security”, Tata Mc Graw Hill.
3. Mark Stamp’s Information Security Principles and Practice, Wiley
4. Bernard Menezes, “Cryptography & Network Security”, Cengage Learning.

References:

1. Applied Cryptography, Protocols, Algorithms and Source Code in C, Bruce Schneier, Wiley.
2 Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/
2.	https://nptel.ac.in/
3.	https://www.coursera.org/

Assessment:

Internal Assessment and End Semester Exam Question Paper Structure
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	
2615211603	**Microcontroller and Embedded Programming**	3	-	--	45	--	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
2615211603	**Microcontroller and Embedded Programming**	20	20	40	60	2.5	--	--	100

Rationale:

The microcontrollers and embedded systems subject provides knowledge in automation and electronic devices. It helps students learn programming, hardware interfacing, and real-time application development, which are essential for careers in embedded systems, IoT, robotics, and automation industries

Course Objectives:

1. To conceptualize the architecture of embedded systems.
2. To study the basics of microcontroller 8051.
3. To elaborate on the concepts of microcontroller interfacing.
4. To understand the concepts of ARM architecture
5. To learn serial communication protocols and their applications in embedded systems.
6. To understand the concepts, architecture, and applications of Real Time Operating Systems (RTOS).

Course Outcomes:

1. Explain the fundamentals of embedded systems. (L1, L2)
2. Apply the knowledge of 8051 Microcontroller architecture. (L3)
3. Design and implement interfacing of 8051 with external peripherals and devices. (L4, L5)
4. Apply the concepts of ARM7 architecture, instruction set, pipelining, and assembly language programming. (L3).
5. Apply the concept of serial communication protocols. (L2. L3)
6. Explain the concept of Real Time Operating Systems (RTOS). (L3)

Prerequisite: C Programming, Basic of operating System.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Embedded systems**	**Embedded systems:** Definition, characteristics, constraints; processor embedded into a system; embedded hardware units and devices in a system; embedded software in a system; design process in embedded system; classification of embedded systems. **Processor technology:** general purpose processor, application specific processor, single purpose processor. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.	**7**	**CO1**
		Self-learning Topics: Comparison of CISC & RISC, Case studies of Real Time Embedded Systems.	**7**	
II	**The Microcontroller Architecture and Programming of 8051**	Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory Organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts. Addressing modes, Instruction set 8051 developing tools, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR.	**8**	**CO2**
		Self-learning Topics: Writing 8051 programming in Embedded C	**8**	
III	**Interfacing with 8051 Microcontroller**	**Interfacing 8051 with peripherals:** ADC, DAC, stepper motor .Interfacing 8051 with LED, LCD, keyboard, Temp Sensor , etc. using assembly language.	**7**	**CO3**
		Self-learning Topics: Study of 8051 based GSM, Bluetooth and RS232 communication	**7**	
IV	**ARM 7 Architecture**	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, addressing modes, Instruction set: Data processing, Data Transfer, Control flow. Pipelining, Writing simple assembly language programs. Brief introduction to exceptions and interrupts handling.	**8**	**CO4**
		Self-learning Topics: Writing ARM programs in Embedded C and Python for sensor application	**8**	
V	**Serial Communication Protocols**	Basics of serial communication, Synchronous and asynchronous communication, UART protocol and interfacing, SPI protocol fundamentals, I2C protocol fundamentals, RS-232 communication, Applications of serial communication protocols.	**7**	**CO5**
		Self-learning Topics: CAN Protocol in Automotive Embedded Systems ,Sensor Interfacing Using SPI	**7**	

		Communication Applications of Serial Communication in Industrial Automation .		
VI	**RTOS** **Real Time system concept with embedded OS**	**Basics of RTOS**: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, Basic architecture of an RTOS, scheduling systems, Inter-process-communication using pipes and mailboxes, interrupt management in RTOS environment, RTOS comparative study. **Case study:** Case study of RTOS in Anti-Lock Braking System (ABS)	**8**	**CO6**
		Self-learning Topics: Inter-process-communication using Semaphore and Mutex, RTOS simple programming using ucos2	**8**	

Textbooks:

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay," The 8051 microcontroller & Embedded systems Using Assembly and C", Pearson, 3rd edition
2. The 8051 Microcontroller and Embedded Systems — Muhammad Ali Mazidi, Janice Gillispie Mazidi, Pearson Education
3. Real-Time Concepts for Embedded Systems — Qing Li & Caroline Yao, CRC Press

References:

1. Steve Furber, "ARM System on chip Architecture", Pearson, edition second
2. Laya B. Das, "Embedded systems an integrated approach", Pearson, Third impression, 2013
3. Embedded Systems, Architecture, program and Design by Rajkamal
4. Programming Embedded Systems — Michael Barr & Anthony Massa, O'Reilly Publication.
5. Massimo Banzi, "Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)", O'Reilly Media.

Online References:

Sr. No	Website Name
1	https://nptel.ac.in/courses/106/102/106102064
2	Course (swayam2.ac.in)
3	https://www.coursera.org/learn/raspberry-pi-platform

Assessment:

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	
2615212604	DS using Python Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract / Oral	Total
		IAT I	IAT II	Total					
2615212604	DS using Python Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To know the fundamental concepts of data science and analytics.
2. To learn data collection, preprocessing and visualization techniques for data science.
3. To Understand and practice analytical methods for solving real life problems based on Statistical analysis.
4. To learn various machine learning techniques to solve complex real-world problems.
5. To learn streaming and batch data processing using Apache Spark.
6. To map the elements of data science to perceive information.

Lab Outcomes:

1. Understand the concept of Data science process and associated terminologies to solve real-world problems. (L1)
2. Analyze the data using different statistical techniques and visualize the outcome using different types of plots. (L1, L2, L3, L4)
3. Analyze and apply the supervised machine learning techniques like Classification, Regression or Support Vector Machine on data for building the models of data and solve the problems. (L1, L2, L3, L4)
4. Apply the different unsupervised machine learning algorithms like Clustering, Decision Trees, Random Forests or Association to solve the problems. (L1, L2, L3)
5. Design and Build an application that performs exploratory data analysis using Apache Spark. (L1, L2, L3, L4, L5, L6)
6. Design and develop a data science application that can have data acquisition, processing, visualization and statistical analysis methods with supported machine learning technique to solve the real-world problem. (L1,L2,L3,L4,L5,L6)

Prerequisite: Basics of Python programming and Database management system.

Detailed Syllabus:

Sr.No.	Module	Detailed Content	Hours	LO Mapping
I	Introduction to Data Science and Data Processing using Pandas	i.Introduction, Benefits and uses of data science i.Data Science tasks i.Introduction to Pandas .Data preparation: Data cleansing, Data transformation, Combine/Merge /Join data, Data loading & preprocessing with pandas .Data aggregation i.Querying data in Pandas i.Statistics with Pandas Data Frames i.Working with categorical and text data .Data Indexing and Selection .Handling Missing Data	05	LO1
II	Data Visualization and Statistics	i.Visualization with Matplotlib and Seaborn i.Plotting Line Plots, Bar Plots, Histograms Density Plots, Paths, 3Dplot, Stream plot, Logarithmic plots, Pie chart, Scatter Plots and Image visualization using Matplotlib i.Plotting scatter plot, box plot, Violin plot, swarm plot, Heatmap, Bar Plot using seaborn .Introduction to scikit-learn and SciPy .Statistics using python: Linear algebra, Eigen value, Eigen Vector, Determinant, Singular Value Decomposition, Integration, Correlation, Central Tendency, Variability, Hypothesis testing, Anova, z- test, t-test and chi-square test.	05	LO2
III	Machine Learning	i. What is Machine Learning? ii. Applications of Machine Learning; iii. Introduction to Supervised Learning iv. Overview of Regression v. Support Vector Machine vi. Classification algorithms	05	LO3
IV	Unsupervised Learning	i. Introduction to Unsupervised Learning ii. Overview of Clustering iii. Decision Trees	05	LO4

		iv. Random Forests v. Association		
V	Data analytics using Apache Spark	i. Introduction to Apache Spark ii. Architecture of Apache Spark iii. Modes and components iv. Basics of PySpark	05	LO5
VI	Case Studies	i. Understanding the different data science phases used in selected case study. ii. Implementation of Machine learning algorithm for selected case study	05	LO6

Text Books:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication.
2. Frank Kane, "Hands-On Data Science and Python Machine Learning", packt publication.
3. M.T. Savaliya, R.K. Maurya, G.M.Magar, "Programming with Python", 2n Edition, Sybgen Learning.

References:

1. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
2. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publishing
3. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications.

Online References:

Sr. No.	Website/Reference link
1.	https://www.w3schools.com/python/pandas/default.asp
2.	https://matplotlib.org/stable/gallery/index.html
3.	https://seaborn.pydata.org/examples/index.html
4.	https://docs.scipy.org/doc/scipy/reference/linalg.html#module-scipy.linalg
5.	https://scikit-learn.org/stable/auto_examples/index.html
6	https://www.tutorialspoint.com/scipy/scipy_integrate.htm\
7	https://machinelearningmastery.com/statistical-hypothesis-tests-in-python-cheat-

8	https://data-flair.training/blogs/data-science-project-ideas/

Suggested List of Experiments:

Sr.No.	**List of Experiments**
1	For the following experiments, use any suitable dataset from sources such as Kaggle, UCI Repository, or other open data sources and implement the tasks using Python.
2	Study and setup of a Machine Learning environment using Python libraries such as NumPy, Pandas, Matplotlib, Seaborn, SciPy, and Scikit-learn.
3	Data preparation and preprocessing using NumPy and Pandas including loading dataset and understanding dataset structure
4	Derive an index field and add it to the dataset
5	Identify and handle missing values in the dataset using suitable techniques
6	Detect outliers in any selected field, list the records containing outliers, and display the 10 largest values for that field.
7	Standardize or normalize a selected variable and identify the number of outliers including the most extreme outlier.
8	Perform Exploratory Data Analysis (EDA) using Matplotlib and Seaborn by creating bar graphs, contingency tables using any two variables, and normalized histograms. Interpret the results obtained from the graphs and tables.
9	Partition the dataset into training and testing sets (for example 75% training and 25% testing) and visualize the proportion using a bar graph.
10	Identify the total number of records in the training dataset and validate the partition using a two-sample Z-test.
11	Implement statistical hypothesis testing using SciPy or Scikit-learn.
12	Apply Supervised Machine Learning – Regression Analysis using algorithms such as Linear Regression to predict values from the dataset
13	Apply Supervised Machine Learning – Logistic Regression or other classification algorithms such as Decision Tree, K-Nearest Neighbors (KNN), or Naïve Bayes and evaluate model performance.
14	Apply Unsupervised Machine Learning – Clustering algorithms such as K-Means or Hierarchical Clustering and visualize cluster distribution.
15	Implement a Machine Learning based Recommendation System using available datasets and perform exploratory data analysis using Pandas or Apache Spark for batch or streamed data analysis.

16	Implementation of Mini project based on following case study using Data science and Machine learning [Any one]

List of Case Studies:

Fake News Detection	Road Lane Line Detection	Sentiment Analysis
Detecting Parkinson's Disease	Brain Tumor Detection with Data Science	Leaf Disease Detection
Speech Emotion Recognition	Gender Detection and Age prediction	Diabetic Retinopathy
Uber Data Analysis	Driver Drowsiness detection	Chatbot Project
Credit Card Fraud Detection	Movie/Web Show Recommendation System	Customer Segmentation
Cancer Classification	Traffic Signs Recognition	Exploratory Data Analysis for Housing price prediction
Coronavirus visualizations	Visualizing climate change	Predictive policing
Uber's pickup analysis	Earth Surface Temperature Visualization	Web traffic forecasting using time series
Coronavirus visualizations	Visualizing climate change	Used Car Price Estimator
Uber's pickup analysis	Earth Surface Temperature Visualization	Used Car Price Estimator
Medical Diagnosis Expert System	Crop Disease Expert System	AI-based Voice Assistant using Intelligent Agents
Smart Traffic Management using AI	World University Rankings	and so on ….

Assignments:

1. Recent trends in Data science
2. Comparative analysis between Batch and Streamed data processing tools like Map-reduce, Apache spark, Apache Flink, Apache Samza, Apache Kafka and Apache Storm.

Term Work:

- Term work shall consist of at least 10 experiments and a case study.
- Journal must include 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) (15) Marks.

- Mini project (Implementation) (05) Marks.
- Attendance (05) Marks

TOTAL: **(25) Marks.**

Oral examination will be based on Laboratory work, mini project and 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	
2615212605	Security Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	Term Work	Pract / Oral	Total
		IAT I	IAT II	Total					
2615212605	Security Lab	--	--	--	--	--	25	25	50

Lab Objectives:

1. To apply the knowledge of symmetric cryptography to implement classical ciphers.
2. To analyze and implement public key encryption algorithms, hashing and digital signature algorithms.
3. To explore the different network reconnaissance tools to gather information about networks.
4. To explore the tools like sniffers, port scanners and other related tools for analyzing.
5. To Scan the network for vulnerabilities and simulate attacks.
6. To set up intrusion detection systems using open-source technologies and to explore email security.

Lab Outcomes:

1. Illustrate symmetric cryptography by implementing classical ciphers. (L1, L2)
2. Demonstrate Key management, distribution and user authentication. (L1, L2)
3. Explore the different network reconnaissance tools to gather information about network. (L1, L2, L3)
4. Use tools like sniffers, port scanners and other related tools for analyzing packets in a network. (L1, L2,L3)
5. Use open-source tools to scan the network for vulnerabilities and simulate attacks. (L1, L2, L3)
6. Demonstrate the network security system using open source tools. (L1, L2)

Prerequisite: Basic concepts of Computer Networks & Network Design, Operating System

Hardware & Software Requirements:

Hardware Requirement	Software requirement
PC With following Configuration • Intel Core i3/i5/i7 Processor	• Windows or Linux Desktop OS wireshark

• 4 GB RAM • 500 GB Harddisk	• ARPWATCH • Kismet, NetStumbler NESSU

Detailed Syllabus:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Classical Cryptography & Substitution Techniques	Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher)	05	LO1
II	Modern Cryptography: Block Ciphers, Public Key & Digital Security	Block cipher modes of operation using a)Data Encryption Standard b)Advanced Encryption Standard (AES). Public key cryptography: RSA algorithm. Hashing Techniques: HMAC using SHA Digital Signature Schemes – RSA, DSS.	05	LO2
III	Network Reconnaissance & Packet Analysis	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars. Study of packet sniffer tools Wireshark,:- a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.	05	LO3
IV	Port Scanning & Network Mapping with Nmap	Download and install nmap. Use it with different options to scan open ports, perform fingerprinting, ping scan, tcp port scan, udp port scan, etc.	05	LO4
V	Cyber Attacks, Keylogging & Vulnerability Assessment	Keylogger attack using a keylogger tool. Simulate DOS attack using Hping or other tools.Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.	05	LO5
VI	System Security	Set up IPSec under Linux. Set up Snort and study the logs. Explore the GPG tool to implement email security	05	LO6

Text Books

1. Build your own Security Lab, Michael Gregg, Wiley India.
2. CCNA Security, Study Guide, TIm Boyles, Sybex.
3. Hands-On Information Security Lab Manual, 4th edition, Andrew Green, Michael Whitman, Herbert Mattord.
4. The Network Security Test Lab: A Step-by-Step Guide Kindle Edition, Michael Gregg.

References:

1. Network Security Bible, Eric Cole, Wiley India.
2. Network Defense and Countermeasures, William (Chuck) Easttom.
3. Principles of Information Security + Hands-on Information Security Lab Manual, 4th Ed., Michael Whitman , Herbert J. Mattord.

Online References:

Sr. No.	Website/Reference link
1.	IITB virtual Lab: http://cse29-iiith.vlabs.ac.in/
2.	https://www.dcode.fr/en

Suggested List of Experiments:

Sr.No	Experiment Title
1.	Breaking the Mono-alphabetic Substitution Cipher using Frequency analysis method.
2.	Design and Implement a product cipher using Substitution ciphers.
3.	Cryptanalysis or decoding Playfair, vigenere cipher.
4.	Encrypt long messages using various modes of operation using AES or DES.
5.	Cryptographic Hash Functions and Applications (HMAC): to understand the need, design and applications of collision resistant hash functions.
6.	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA.
7.	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
8.	Study of packet sniffer tools wireshark: - a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.
9.	Download, install nmap and use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.
10.	Study of malicious software using different tools: a) Keylogger attack using a keylogger tool. b) Simulate DOS attack using Hping or other tools c) Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.
11.	Study of Network security by a) Set up IPSec under Linux. b) Set up Snort and study the logs. c) Explore the GPG tool to implement email security

Term Work: Term Work shall consist of at least 12 to 15 practical's 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 Practical & Oral exam 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	
2615812606	Dissertation- I	-	-	2	-	-	30	-	30	1

Couse Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duratio (in Hrs	Term Work	Pract / Oral	Total
		IAT I	IAT II	Total					
2615812606	Dissertation- I	--	--	--	--	--	50	50	100

Course Objectives

1. To identify and analyze societal and research-oriented engineering problems using scientific principles, standard engineering practices, and critical thinking skills.
2. To apply technical knowledge, practical skills, and experimental or theoretical methods for designing innovative and sustainable solutions to real-world societal challenges.
3. To develop teamwork, leadership, interpersonal, and project management abilities for effective collaboration in multidisciplinary environments.
4. To interpret and evaluate experimental, theoretical, and simulation data in order to make informed decisions and solve engineering problems efficiently.
5. To assess the societal, environmental, and ethical impacts of engineering solutions with emphasis on sustainability, professional responsibility, and eco-friendly practices.
6. To enhance written and oral communication skills along with self-learning capabilities that promote professional growth and lifelong learning.

Course Outcome: Learner will be able to…

1. Identify and analyze societal or research-based problems using engineering knowledge and standard practices.
2. Apply technical knowledge, skills, and experimental/theoretical methods to develop sustainable solutions for societal problems.
3. Work effectively as a team member or leader while demonstrating interpersonal and project management skills.

4. Draw meaningful inferences from experimental, theoretical, and simulation results for problem-solving and decision-making.
5. Analyze the societal and environmental impact of engineering solutions with a focus on sustainability and ethical practices.
6. Demonstrate effective written and oral communication along with self-learning abilities that support lifelong learning.

Guidelines for Major Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of Dissertation- I and Dissertation- II.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during Dissertation- I & II activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Dissertation- I, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Dissertation-I in semester VI and Dissertation-II - in semesters VII.
- 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 motivate for
- Copyright or Indian Patent as an extension of the Dissertation- I with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Dissertation:

Term Work

1. The review/ progress monitoring committee shall be constituted by head of departments of each

institute. The progress of Dissertation to be evaluated on 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 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 copyright or Indian patent in last month of the said semester.

Assessment criteria of Dissertation.

Dissertation 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's as member or leader

13. Clarity in written and oral communication

- In one year, project, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.

Guidelines for Assessment of Dissertation Practical/Oral Examination:

- Report should be prepared as per the guidelines provided.
- Dissertation shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Dissertation 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 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	
26152216701	Image Processing	3	--	--	45	--	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
26152216701	Image Processing	20	20	40	60	2.5	--	--	100

Rationale:

Image Processing syllabus is designed to help students understand techniques for enhancing and analyzing digital images. It covers fundamental concepts and practical skills required in fields like medical imaging, AI, and multimedia, preparing students for real-world applications and industry needs.

Course Objectives:

1. To define image and its formation and debate about the roles of image processing in today's world and also introduce students to the major research domains in the field of image processing.
2. To describe point, mask and histogram processing units of image enhancements that can be applied on a given image for improving the quality of digital image required for an application.
3. To explain the forward and reverse discrete image transforms and discuss the selection of the image transform used for enhancement, compression, or representation and description.
4. To make students understand the impacts and effects of image compression techniques over a given bandwidth to learn how effectively storage and retrieval can be achieved using lossy and lossless compression methods.
5. To describe and demonstrate the proper procedure for segmenting images, and demonstrate how the image object can be described using image representation techniques.
6. To illustrate how to shape and reshape a given object in an image using morphological techniques over binary and gray scale images.

Course Outcomes:

1. Define and explain image and explain formation of image and recall its types and calculate image parameters by reading images using a programming language. (L1)

2. Apply and differentiate point, mask and histogram processing techniques suitable for enhancing images required for an application. (L1,L2,L3)

3. Demonstrate discrete image transform coefficients and use it for enhancement, compression and representation. (L1, L2, L3)
4. Define and apply compression ratio and fidelity criteria to evaluate and compare method efficiency and classify compression techniques into lossless and lossy methods. (L1, L2, L3, L4)
5. Implement the segmentation techniques to highlight and select the region of interest and determine and describe using chain code, shape number and moments for representing objects in an image. (L1, L2, L3)
6. Define and apply structuring elements and apply morphological operations to find a suitable shape for an object in the image. (L1, L2, L3)

Prerequisite: Digital Signal Processing.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Image Processing**	Image Fundamentals: Image Definition, Steps and Components of Image Processing, Image Sensing and Acquisition, Image Sampling and Quantization. Relationship between Pixels: Adjacency, Connectivity and Distance.	**7**	**CO1**
		Self-learning Topics: Different Image File Formats and Types of noise in image	**7**	
II	**Image Enhancement**	Point Processing Techniques: Image Negative, Bit Plane Slicing, Gray Level Slicing, Contrast Stretching, Clipping, Thresholding, Dynamic Range Compression. Mask Processing Techniques: Filtering in Spatial Domain, Average Filter, Weighted Average Filter, Order Statistic Filter: Min, Max, Median Filter. Histogram Processing: Histogram Equalization and Specification.	**8**	**CO2**
		Self-learning Topics: Application of Image Enhancement in Spatial Domain	**8**	
III	**Image Transforms**	Discrete Fourier Transform: Transform Pair, Transform Matrix, Properties, Filtering in Frequency Domain.Other Discrete Transforms: Discrete Cosine Transform, Discrete Hadamard Transform, Discrete Walsh, Transform, Discrete Haar Transform.	**7**	**CO3**
		Self-learning Topics : Application of Transforms in Steganography and CBIR.	**7**	

IV	**Image Compression**	Entropy, Redundancy and Types, Compression Ratio, Compression Methods. **Lossless Compression:** Run-Length Encoding, Huffman Coding, Arithmetic Coding, LZW Coding, Lossless Predictive coding. **Loss Compression:** Fidelity Criterion, Improved Gray Scale Quantization, Symbol-Based Coding, Bit-Plane Coding, Vector Quantization.	**7**	**CO4**
		Self-learning Topics: DPCM, Block Transform Coding, JPEG compression**.**	**7**	
V	**Image Segmentation and Representation**	**Image Segmentation:** Point, Line and Edge Detections Methods, Hough Transform, Graph Theoretic Method, Region Based Segmentation. **Image Representation:** Chain Codes, Shape Number, Polygon Approximation, Statistical Moments.	**8**	**CO5**
		Self-learning Topics: Fourier Descriptors, Otsu Thresholding, Application in Number Plate Recognition.	**8**	
VI	**Morphological Image Processing**	Basic Morphological: Methods: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation. Advanced Morphological Methods: Skeletonization, Thinning, Thickening,Pruning, Boundary Extraction.	**8**	**CO6**
		Self-learning Topics: Gray Scale Morphology: Erosion and Dilation.	**8**	

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Addison - Wesley Publishing Company, 3e, 2007.
2. William K. Pratt, “Digital Image Processing”, John Wiley, 4e, 2007.
3. S. Jayaraman, S. Esakkirajan and T. Veerakumar, “Digital Image Processing”, MGH Publication, 2016.

References:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing using MATLAB,” Pearson Education.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal processing Principles, Algorithms and Applications,” PHI Publications, 3e.
3. Anil K. Jain, “Fundamentals of Digital Image Processing,” PHI, 1995.
4. Milan Sonka, “Digital Image Processing and Computer Vision,” Thomson publication, Second Edition.2007.
5. Kenneth R. Castleman, “Digital Image Processing,” PHI, 1996.
6. S. Sridhar, “Digital Image Processing,” Oxford University Press, 2e, 2016.

Online References:

Sr. No.	Website Name
1.	NPTEL : Digital Image Processing - Course
2.	NDLI : NDLI: Digital Image Processing

Assessment:

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	
26152216702	High Performance Computing	3	-	--	45	-	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
26152216702	High Performance Computing	20	20	40	60	2.5	--	--	100

Rationale

High Performance Computing (HPC) enables efficient solution of complex computational problems using parallel processing techniques and advanced architectures. The increasing demand for high-speed computation in areas such as scientific research, artificial intelligence, simulations, and big data analytics has made HPC an essential technology. This course introduces students to parallel computing concepts, performance optimization, and modern programming paradigms. It also provides knowledge of GPU computing and scalable systems required for developing high-performance applications.

Course Objectives:

1 To understand fundamental concepts and importance of High Performance Computing (HPC).
2 To understand knowledge of modern processor architectures and parallel computing platforms.
3 Understand the design and implementation of parallel algorithms.
4 To analyze performance metrics and scalability of HPC systems.
5 To introduce parallel programming paradigms such as MPI and Open MP.
6 To understand concepts of GPU computing and heterogeneous computing tools.

Course Outcomes:

1. Understand fundamental concepts of parallel computing and HPC systems. (L1,L2)
2. Describe modern processor architectures and optimization techniques. (L1, L2,L3)
3. Explain different parallel computing architectures and platforms. (L1, L2)
4. Evaluate performance metrics and scalability of HPC systems.(L2, L3, L4)
5. Apply parallel programming paradigms using MPI/OpenMP. (L2, L3)

6. Understand GPU computing and heterogeneous computing tools (L1, L2)

Prerequisite: Computer Organization Programming, Data Structures and Algorithms, Basic knowledge of Operating Systems

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to High Performance Computing**	**Introduction to Parallel Computing**: Motivation for Parallel Computing, Need for High Performance Computing, Scope and Applications of HPC. **Levels of Parallelism:** Instruction Level Parallelism, Data Parallelism, Task Parallelism, Thread Level Parallelism. **Parallel Computing Models:** SIMD, MIMD, SIMT, SPMD, Dataflow Models. Basic Concepts of Parallel Architecture and Multiprocessor Systems.	**7**	**CO1**
		Self-learning Topics: Interconnection networks, processor arrays, and multiprocessor systems.	**7**	
II	**Modern Processor Architectures and Optimization Techniques**	**Modern Processors:** Stored Program Computer Architecture, Cache-based Microprocessors, Performance Metrics and Benchmarks, Moore's Law. Processor Architecture Concepts: Pipelining, Superscalar Processors, Multicore Processors, Multithreaded Processors, Vector Processors. **Basic Optimization Techniques for Serial Code:** Compiler Optimizations, Loop Optimization, Function Inlining, Memory Access Optimization, Avoiding Branches.	**8**	**CO2**
		Self-learning Topics: Hardware performance counters and compiler optimization techniques	**8**	
III	**Parallel Computing Platforms and Architectures**	Parallel Computing Platforms: Physical Organization of Parallel Systems. Shared Memory Architecture (UMA, NUMA).Distributed Memory Architecture. Hierarchical Systems. **Network Architectures:** Bus-based networks, switched networks, mesh networks, fat-tree networks. **Parallelization Concepts:** Data Parallelism, Functional Parallelism, Parallel Scalability	**7**	**CO3**
		Self-learning Topics : Hybrid parallel architectures and network topologies	**7**	

IV	**Performance Metrics and Scalability in HPC**	**Performance Evaluation Metrics:** Execution Time, Speedup, Efficiency, Throughput, Cost. **Scalability Analysis:** Scalability of Parallel Systems, Effect of Granularity, Load Balancing. **Performance Laws:** Amdahl's Law, Gustafson's Law. Performance Bottlenecks: Communication Overhead, Synchronization Overhead, Memory Bottlenecks.	**8**	**CO4**
		Self-learning Topics: Performance tuning techniques	**8**	
V	**Parallel Programming Paradigms**	Message Passing Programming: Principles of Message Passing Paradigm. Message Passing Interface (MPI). Send and Receive Operations. Point-to-Point Communication. Collective Communication. **Parallel Algorithms and Applications**: Matrix Vector Multiplication. Sorting Algorithms (Sample Sort). Graph Algorithms	**7**	**CO5**
		Self-learning Topics: Introduction to OpenMP Programming.	**7**	
VI	**GPU Computing and Parallel Programming Tools**	**General Purpose GPU Computing (GPGPU):** GPU Architecture and Components. Introduction to GPU Programming. **OpenCL Architecture:** OpenCL Platform Model, Execution Model, Memory Model. **OpenCL Programming Basics:** Kernel Programming, Parallel Execution. **Introduction to CUDA:** CUDA Architecture, CUDA Programming Model	**8**	**CO6**
		Self-learning Topics: Performance comparison between CPU and GPU computing.	**8**	

Text Books:

1 Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Pearson Education.
2 Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill.
3 Edward Kandrot and Jason Sanders, "CUDA by Example – An Introduction to General Purpose GPU Programming", Addison Wesley.
4 Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", CRC Press

References:

1 Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw Hill.
2 Kai Hwang and Zhiwei Xu, "Scalable Parallel Computing: Technology, Architecture and Programming", McGraw Hill.
3 Laurence T. Yang and Minyi Guo, "High Performance Computing: Paradigm and Infrastructure", Wiley.
4 Fayez Gebali, "Algorithms and Parallel Computing", Wiley

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/106/106106090/
2.	https://nptel.ac.in/courses/106/103/106103224/
3.	https://nptel.ac.in/courses/117105083
4.	https://www.top500.org

Assessment:

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	
26152216703	**Information Retrieval System**	3	--	--	45	--	-	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
26152216703	**Information Retrieval System**	20	20	40	60	2.5	--	--	100

Rational

With the rapid growth of digital data and web-based information, efficient retrieval of relevant information has become essential. This course introduces the fundamental concepts, models, and techniques used in Information Retrieval systems. It enables students to understand how search engines, indexing methods, and retrieval algorithms work in real-world applications. The course also covers modern aspects such as multimedia retrieval and visualization, preparing students to design and implement effective information retrieval solutions for large-scale data environments.

Course Objectives:

1 To learn the fundamentals of the information retrieval system.
2 To classify various Information retrieval models.
3 To demonstrate the query processing techniques and operations.
4 To compare the relevance of query languages for text and multimedia data.
5 To evaluate the significance of various indexing and searching techniques for information retrieval.
6 To develop an effective user interface for information retrieval.

Course Outcomes:

1 Define and describe the objectives of the basic concepts of the Information retrieval system. (L1,L2)
2 Evaluate the taxonomy of different information retrieval models. (L1,L2,L3,L4)
3 Try to solve and process text and multimedia retrieval queries and their operations. (L1,L2)

4 Evaluate text processing techniques and operations in the information retrieval system. (L1,L2,L3,L4)
5 Demonstrate and evaluate various indexing and searching techniques. (L1,L2,L3,L4)
6 Design the user interface for an information retrieval system. (L1,L2,L3,L4)

Prerequisite: Data Structures, DBMS, Discrete Mathematics

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Information Retrieval**	Motivation and basic concepts of Information Retrieval, components and types of information systems, definition and objectives of Information Retrieval Systems, Information Retrieval vs Data Retrieval, overview of search engines and browsers, retrieval process and basic IR architecture.	**7**	**CO1**
		Self-learning Topics: Working of modern search engines, Web crawling and indexing basics, Evaluation metrics for IR systems (Precision, Recall, F-measure).	**7**	
II	**Information Retrieval Models**	Taxonomy of IR models, formal characteristics of retrieval models, classical models such as Boolean, Vector Space and Probabilistic models, alternative set theoretic models, structured text retrieval models and browsing models.	**8**	**CO2**
		Self-learning Topics: : Open-source IR tools such as Apache Lucene and Elasticsearch, Comparative study of IR models, Applications of IR models in web search**.**	**8**	
III	**Query Processing and Operations**	Query languages including keyword-based querying, pattern matching and structural queries, query protocols, query operations such as relevance feedback, introduction to multimedia information retrieval models and basic data modeling.	**7**	**CO3**
		Self-learning Topics : Proximity and wildcard queries, Query expansion techniques, Multimedia query processing.	**7**	
IV	**Text Processing Techniques**	Text and multimedia languages and their properties, metadata and markup languages, document preprocessing techniques, tokenization and normalization, document clustering techniques for organizing document collections.	**7**	**CO4**
		Self-learning Topics: Tokenization and stop-word removal, Applications of text mining, Digital library systems such as Greenstone.	**7**	

V	**Indexing and Searching Techniques**	Inverted file structures, indexing methods for text retrieval, Boolean queries, sequential searching and pattern matching, structural queries, compression techniques, multimedia indexing and feature extraction, web searching challenges and hyperlink based searching.	**8**	**CO5**
		Self-learning Topics: PageRank algorithm and link analysis, Web search engine architecture, Metadata standards used in information retrieval	**8**	
VI	**User Interface and Visualization in IR**	Human-computer interaction in information access, user interface design for IR systems, query specification methods, relevance judgments, interface support for search process, basics of visualization for information retrieval systems	**8**	**CO6**
		Self-learning Topics: Information visualization tools (Tableau, D3.js), Multimedia search engines, Usability evaluation of search interfaces	**8**	

Text Books:

1 Modern Information Retrieval, Ricardo Baeza-Yates, Berthier Ribeiro- Neto, ACM Press-Addison Wesley
2 Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher
3 Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India.

References Books:

1 Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press.
2 Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons
3 Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman.

Online References:

Sr.No	Website Name
1	https://www.geeksforgeeks.org/what-is-information-retrieval/
2	https://nlp.stanford.edu/IR-book/
3	https://en.wikipedia.org/wiki/Information_retrieval
4	https://people.ischool.berkeley.edu/~hearst/irbook/10/node1.html

Assessment:

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	
26152216704	Wireless Technology	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
26152216704	Wireless Technology	20	20	40	60	2.5	--	--	100

Rationale:

This course provides fundamental and advanced knowledge of wireless communication systems, starting from basic concepts to modern technologies like 5G. It covers essential multiple access techniques such as FDMA, TDMA, and CDMA, along with cellular networks like GSM and LTE. The syllabus also includes wireless LAN, PAN, and IoT technologies such as Wi-Fi and Bluetooth, along with security and network design concepts. This helps students understand real-world wireless systems and prepares them for careers in telecommunications and networking.

Course Objectives:

1 Discuss the Fundamentals of Wireless Communication.
2 Comprehend the Fundamental Principles of Wide Area Wireless Networking Technologies and their Applications.
3 Explain Wireless Metropolitan and Local Area Networks.
4 Describe Wireless Personal Area Networks and Ad hoc Networks
5 Learn and Analyze Wireless Network Security Standards.
6 Study the Design Considerations for Wireless Networks.

Course Outcomes:

1 Describe the basic concepts of Wireless Network and Wireless Generations. (L1,L2)
2 Demonstrate and Evaluate the various Wide Area Wireless Technologies. (L1,L2,L3, L4, L5)
3 Analyze the prevalent IEEE standards used for implementation of WLAN and WMAN Technologies. (L1,L2,L3,L4)
4 Appraise the importance of WPAN, WSN and Ad-hoc Networks. (L1,L2,L3,L4,L5)

5 Analyze various Wireless Network Security Standards. (L1,L2,L3,L4)
6 Review the design considerations for deploying the Wireless Network Infrastructure. (L1,L2)

Prerequisite: Principle of Communication, Computer Network and Network Design, Computer Network Security.

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Wireless Communication**	Introduction to Wireless Communication -Advantages, Disadvantages and Applications; Multiple Access Techniques - FDMA, TDMA, CDMA, OFDMA; Spread Spectrum Techniques –DSSS, FHSS; Evolution of wireless generations –1G to 5G (Based on technological differences and advancements); 5G – Key requirements and drivers of 5G systems, Use cases, Massive MIMO.	**7**	**CO1**
		Self-learning Topics: Radio Wave Propagation Models, Antenna Basics for Wireless Systems, Spectrum Management and Allocation, Wireless QoS Parameters, Role of AI in 5G Wireless Networks, Impact of Environmental Factors on Wireless Signal Propagation (Urban, Rural, Indoor), Wireless Communication in Smart Consumer Electronics (Smartphones, Wearables, IoT Devices).	**7**	
II	**Wide Area Wireless Networks**	Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, co- channel interference and signal quality; GSM – System Architecture, GSM Radio Subsystem, Frame Structure; GPRS and EDGE – System Architecture; UMTS – Network Architecture; CDMA 2000 – Network Architecture; LTE –Network Architecture; Overview of LoRa & LoRaWAN.	**8**	**CO2**
		Self-learning Topics: : Cellular Network Planning and Optimization, Handoff Algorithms in Cellular Networks, Energy Efficiency Techniques in Cellular Base Stations (Green Communication), Carrier Aggregation in LTE-Advanced, NB-IoT and LTE-M Technologies, Role of Satellite Integration with 4G/5G Networks, Emergency Communication Systems in Disaster Scenarios (Cell Broadcast & Public Safety Networks), Evolution and Deployment Challenges of Private 5G Networks (Industry 4.**0).**	**8**	

III	**Wireless Metropolitan and Local Area Networks**	IEEE 802.16 (WiMax) – Mesh mode, Physical and MAC layer; IEEE 802.11(Wi-Fi) – Architecture, Protocol Stack, Enhancements and Applications.	**7**	**CO3**
		Self-learning Topics : Wi-Fi 6 and Wi-Fi 7 Technologies, Mesh Networking in Smart Campuses, WLAN Site Survey Techniques, Wi-Fi Roaming Behavior in High-Density User Environments, Green WLAN Technologies, Performance Benchmarking of Indoor vs Outdoor WLAN Deployments.	**7**	
IV	**Wireless Personal Area Networks and Ad hoc Networks**	IEEE 802.15.1 (Bluetooth) – Piconet, Scatter net, Protocol Stack; IEEE 802.15.4 (ZigBee) – LR-WPAN Device Architecture, Protocol Stack; Wireless Sensor Network – Design Considerations, Issues and Challenges, WSN Architecture, Applications; Introduction of Ad hoc Networks – MANET and VANET –Characteristics, Applications, Advantages and Limitations; Over view of E-VANET(Electrical Vehicular AdHoc Networks).	**7**	**CO4**
		Self-learning Topics: Bluetooth Low Energy (BLE) Applications, Internet of Vehicles (IoV), Drone-based Wireless Ad Hoc Networks, Routing Protocols in MANETs, Wireless Body Area Networks (WBAN), Intelligent Transportation Systems using VANET Data Exchange, Energy Harvesting Techniques in Wireless Sensor Networks.	**7**	
V	**Wireless Network Security**	Security in GSM; UMTS Security; Bluetooth Security; WEP; WPA2.	**8**	**CO5**
		Self-learning Topics: Wireless Intrusion Detection Systems (WIDS), Security in 5G Networks, Ethical Hacking in Wireless Networks, Security Challenges in Public Wi-Fi Networks (Hotspots, Airports, Cafes), VPN and Secure Wireless Communication, Privacy Issues in Location-Based Wireless Services, Zero Trust Architecture in Wireless Networks	**8**	
VI	**Wireless Network Design Considerations**	Cisco Unified Wireless Network; Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers.	**8**	**CO6**
		Self-learning Topics: RF Site Survey and Wireless Network Deployment, High-Density Wireless Network Design, Cloud-Managed Wireless Networks, Wireless Network Troubleshooting Techniques, Case Study: Design Challenges in Metro Railway Wireless Communication Systems	**8**	

Text Books:

1 Wireless Communications, T.L. Singal, McGraw Hill Education.
2 Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers.
3 Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
4 5G Outlook–Innovations and Applications ,Ramjee Prasad ,River Publishers Series in Communications.
5 Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press.

Reference Books:

1 Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley.
2 Wireless Communications- Principles & Practice, Theodore S. Rappaport, Prentice Hall Series.
3 Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall.
4 Adhoc & Sensor Networks Theory and Applications, Carlos de Morais Cordeiro Dharma Prakash Agrawal, World Scientific,2nd Edition.
5 Wireless Networks, Nicopolitidia, M S Obaidat, GI Papadimitriou, Wiley India (Student Edition, 2010).

Online References:

Sr. No.	Website/Reference link
1.	www.swayam.gov.in
2.	www.coursera.org
3.	https://doi.org/10.1007/978-3-642-17878-8_63
4.	https://doi.org/10.1007/978-3-642-54525-2_44
5.	https://lora-alliance.org/resource_hub/what-is-lorawan/
6.	https://doi.org/10.1007/s42835-021-00687-8

Assessment:

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	
26152216705	Disaster Management and Mitigation	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
26152216705	Disaster Management and Mitigation	20	20	40	60	2.5	--	--	100

Rationale:

This course provides students with knowledge of natural and man-made disasters, their causes, impacts, and mitigation strategies. It develops awareness about disaster preparedness, emergency response, rescue operations, and rehabilitation measures. The course also introduces disaster management policies, institutional frameworks, and the role of government and relief agencies in India. Overall, it helps students build problem-solving, decision-making, and community resilience skills for effective disaster risk reduction.

Course Objectives:

1 To understand physics and various types of disaster occurring around the world
2 To identify extent and damaging capacity of a disaster
3 To study and understand the means of losses and methods to overcome /minimize it.
4 To understand role of individual and various organization during and after disaster
5 To understand application of GIS in the field of disaster management
6 To understand the emergency government response structures before, during and after disaster

Course Outcomes:

1. To Understand disaster and their potential effects on the economy. (L2)
2. To Understand natural as well as manmade disasters. (L2)
3. To Get acquainted with the knowledge of government policies, acts and various

organizational structure. (L1, L2, L3,L4)

4. To understand institutional framework and use of IT for effective disaster management (L1,L2,L3,L4)
5. To understand role of individual and various organization during and after Disaster. (L1,L2,L4)
6. To Get acquainted with knowledge of government policies, act and organizational structure. (L1,L2)

Prerequisite: Environmental Science

Detailed Syllabus:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Concepts and definition of Disaster, Hazard, Vulnerability and Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), Risk, Capacity Nature, Importance, Scope of Disaster Management, Disaster: Types, causes, consequences and disaster reduction strategies.	**7**	**CO1**
		Self-learning Topics: Role of Developmental Activities (such as dams, urbanization, and land-use changes) in Increasing Disaster Vulnerability.	**7**	
II	**Categories of Disaster**	Natural disasters: Geological Disasters (earthquakes, landslides, tsunami, volcanic eruption); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder storms, hail storms, avalanches, droughts, cold and heat waves). Man-made Disasters: Chemical disasters, biological disasters, radiological disasters, nuclear disasters, building collapse, Fire –building fire, coal fire, forest fire, Oil fire, Accidents- road accidents, rail accidents, air accidents, sea accidents, Biological Disasters (epidemics, pest attacks, forest fire)	**8**	**CO2**
		Self-learning Topics: : Comparative Study of Natural Disasters and Man-Made Disasters: Causes, Impacts, and Prevention Strategies	**8**	
III	**Disaster Management Policy**	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and coordination of in	**8**	**CO3**

		disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process		
		Self-learning Topics : Use of Technology and Communication Systems in Disaster Administration.	**8**	
IV	**Institutional Framework for Disaster Management in India:**	Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.	**7**	**CO4**
		Self-learning Topics: : Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS	**7**	
V	**Financing Relief Measures**	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	**8**	**CO5**
		Self-learning Topics: Role of Government, NGOs, and International Relief Agencies in Disaster Relief and Rehabilitation	**8**	
VI	**Preventive and Mitigation Measures:**	Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.	**7**	**CO6**
		Self-learning Topics: Do's and Don'ts in case of disasters and effective implementation of relief aids.	**7**	

Text Books:

1. Disaster Management' by Harsh K.Gupta, Universities Press Publications.

2. Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications

References:

1. Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group
2. Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
3. Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications.

Online References:

Sr. No.	Website/Reference link
1.	https://www.nidm.gov.in/Default.asp?utm_source=chatgpt.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 Credit (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
2698451609	Professional Communication and Ethics - II	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory Examination Scheme					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT I	IAT II	Total					
2698451609	Professional Communication and Ethics - II	--	--	--	--	--	25	--	25

Rationale:

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

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

Course Outcomes:

1. Demonstrate effective communication skills, including clarity, confidence, and appropriate body language in professional settings.
2. Participate actively in group discussions by presenting ideas logically, listening effectively, and demonstrating leadership and teamwork.
3. Prepare well-structured resumes aligned with industry standards and customize them for specific job profiles.
4. Perform effectively in interviews by answering HR and behavioral questions using structured techniques like the STAR method.
5. Draft formal business documents such as notices, agendas, and minutes of meetings with proper format and professionalism.

6. Deliver effective presentations and prepare structured reports with clarity, coherence, and

appropriate visual aids.

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**	
II	**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.	**4**	**CO2**
		Self-learning Topics: : Latest GD topics via (Current affairs, social issues, technology)	**4**	
III	**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, Principles of effective resume writing: clarity, conciseness, relevance, Resume customization for different job roles.	**5**	**CO3**
		Self-learning Topics : Industry specific resume formats (IT, Core, Engineering, Managements).	**5**	
IV	**HR/Personal Interviews**	Meaning and types of interviews (HR, technical, behavioral), Common HR interview questions and expected responses, STAR method for answering behavioral questions, Interview etiquette: dress code, body language, communication style, Handling stress	**5**	**CO4**

		questions and tricky situations, Basic interview preparation strategies.		
		Self-learning Topics: Frequently asked HR and behavioral interview questions.	**5**	
V	**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**	
VI	**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**	

Sr. No.	**Documents required to be submitted for internal orals:**
1.	Reflection report on GD.
2.	Resume drafted in latest format.
3.	Corporate meeting – Frame Notice, Agenda, and minutes of the meeting.
4.	Short report format and a case study for the same.

References:

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

Online References:

Sr. No.	**Website/Reference link**
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:

Internal Assessment:

Term work marks – (Total 25 marks)
Group Discussion - 10 marks
Mock PI - 5 marks
Mock Meeting and Role-play -5 marks
Attendance - 5 marks