SYLLABUS

(With effect from 2025-26)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2025–26)

Bachelor Degree

In

Computer Science &Engineering

VII & VIII Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ ಮಂಡ್ಯ–
571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)
Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering

The Vision of the department is:

"The Department of Computer Science and Engineering shall create professionally competent and socially responsible engineers capable of working in global environment.*"*

The mission of the department is:

DM1: Enforce best practices in teaching-learning, with dedicated faculty and supportive infrastructure to impart the knowledge in emerging technologies.

DM2: Improve Industry-Institute relationship for mutual benefit.

DM3: Inculcate ethical values, communication and entrepreneurial skills.

DM4: Sensitize social, legal, environmental and cultural diversity issues through professional training and balanced curriculum.

Program Educational Objectives (PEO's)

Graduates of the program shall

- Ability to have Successful computer professional career in IT industry and related areas
- Pursue higher education in engineering or management with the focus on intensive research and developmental activities.
- Develop their career as entrepreneurs in a Responsible, Professional and ethical manner to serve the society

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (PO's)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problem.
2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess Societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO) which are listed below.

PSO-1: Ability to apply problem solving skills in developing solutions through fundamentals of Computer Science and Engineering.

PSO-2: Ability to apply Analytical Skills in the field of Data Processing Systems.

PSO-3: Ability to design and develop applications through Software Engineering methodologies and Networking Principles.

Bachelor of Engineering (VII–Semester)										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs/Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22CS701	Cryptography & Network Security	CS	3	-	-	3	50	50	100
2	P22CS702X	Professional Elective Course–IV	CS	3	-	-	3	50	50	100
3	P22CS703X	Professional Elective Course -V	CS	3	-	-	3	50	50	100
4	P22CS704	Machine Learning (Integrated)	CS	3	-	2	4	50	50	100
5	P22CS705	Research Methodology, Report Writing and IPR	CS	3	-	-	3	50	50	100
6	P22CS706	Project Work Phase–I	CS	-	-	-	4	100	-	100
Total							**20**			

Professional Elective Course–IV (P22XX702X)	
Course Code	**Course Title**
P22CS7021	Introduction to Generative AI
P22CS7022	Social Network Analysis
P22CS7023	Managing big data
P22CS7024	Natural Language Processing

Professional Elective Course–V (P22XX703X)	
Course Code	**Course Title**
P22CS7031	Mobile Security
P22CS7032	Embedded System and IOT
P22CS7033	High Performance Computing
P22CS7034	Fundamentals of Image Processing

Bachelor of Engineering (VIII–Semester)										
Sl. No.	Course Code	Course Title	Teaching Department	Hrs/Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22CS801	Self-Study Course	CS	-	-	-	2	100	-	100
2	P22INT802	Research/Industry Internship– III	CS	-	-	-	6	50	50	100
3	P22CS803	Project Work Phase–II	CS	-	-	-	8	100	100	100
Total							**16**			

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Cryptography & Network Security**		
Course Code: **P22CS701**	CIE Marks: **50**	CIE Weightage: **50%**
Teaching hours/week (L:T:P): **3:0:0**	SEE Marks: **50**	SEE Weightage: **50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3 Hrs**	
Credits:**3**		

Course learning Objectives:

CLO1: Summarize basic security concepts and apply various symmetric encryption techniques.
CLO2: Compare and contrast various asymmetric encryption techniques and Explain key exchange algorithms.
CLO3: Describe key distribution concepts and User authentication protocols.
CLO4: Describe cloud, E-mail security concepts and analyzes IPSec.

Unit 1	**8 Hours**

Computer & Network security Concepts: Computer Security concepts, security attacks, security services, Security Mechanisms. **Classical Encryption Techniques**: Symmetric Cipher Model, substitution Techniques, Transposition Techniques. **Block Ciphers and the data encryption standard**: Traditional block Cipher structure, stream Ciphers and block Ciphers.

Self-Study Content: Steganography, DES example and strength,The data encryption standard..

Unit 2	**8 Hours**

Public-Key Cryptography and RSA: Principles of public-key cryptosystems. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems**: Diffie-Hellman key exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic.

Self-Study Content: Elliptic curve Cryptography

Unit 3	**8 Hours**

Key Management and Distribution: Symmetric key distribution using Symmetric encryption, Symmetric key distribution using Asymmetric encryption, Distribution of Public Keys, X-509 certificates. **User Authentication:** Remote user Authentication principles, Remote user Authentication Using Symmetric Encryption, Kerberos.

Self-Study Content: Remote user Authentication using Asymmetric encryption and public key infrastructure

Unit 4	**8 Hours**

Network Access Control & Cloud Security: Network Access Control, Extensible Authentication Protocol. **Transport Level Security**: Web Security Consideration, Transport Layer security
Wireless network security: Wireless Security, Mobile Device Security.

Self-Study Content: Cloud Security Risk and Counter measures, HTTPS, Secure shell (SSH).

Unit 5	8 Hours
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email threats and Comprehensive Email Security, S/MIME.**IP Security:** IP Security overview, Encapsulating Security payload.	
Self-Study Content: Cartographic Suits, Pretty Good Privacy, DNSSEC, IP Security Policy.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with Action verbs for the Course topics.	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the concept of network security and encryption techniques.	L2	Understand
CO2	**Apply** Public-key cryptography, RSA and other public-key cryptosystems.	L3	Apply
CO3	**Understand** key management and distribution schemes, Authentication applications and cloud security.	L2	Understand
CO4	**Understand** the issues and structure of Electronic Mail Security and IPSec.	L2	Understand

Suggested Learning Resources:

Textbooks:

1	Cryptography and Network Security	William Stallings	7th edition, 2014	Pearson

Reference Books:

1.	Cryptography and Information Security	V K Pachghare	2nd Edition, 2015	PHI

Web links and Video Lectures (e-resources)

1. https://onlinecourses.nptel.ac.in/noc21_cs16/preview
2. https://www.cs.vsb.cz/ochodkova/courses/kpb/cryptography-and-network-security_-principles-and-practice-7th-global-edition.pdf

CO-PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the concept of network security and encryption techniques.	2	2	2	2		1							2		
CO2	Apply Public-key cryptography, RSA and other public-Key cryptosystem.	2	2	2	2		1							2		
CO3	Understand key management and distribution schemes, Authenticatio n applications and cloud security.	2	2	1												
CO4	Understand the issues and structure of Electronic Mail Security and IPsec.	2	2	1												

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Introduction to Generative AI**		
Course Code: **P22CS7021**	CIE Marks: **50**	CIE Weightage: **50%**
Teaching hours/week (L:T:P) **3:0:0**	SEE Marks: **50**	SEE Weightage: **50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3**	
Credits:**3**		

Prerequisite:

- Basics of Artificial Intelligence, Machine Learning

Course learning Objectives:

CLO1: Understand the core principles and functionalities of Generative AI compared to traditional AI approaches.
CLO2: Explore the various techniques used in GAI, including Generative Adversarial Networks (GANs), Variational Auto encoders (VAEs), Large Language Models (LLMs), and Prompt Engineering.
CLO3: Grasp the data requirements and evaluation metrics used in generative models.
CLO4: Identify real-world applications of Generative AI across different industries, including the Potential of multimodal models combining text, image, audio, and video data.
CLO5: Gain practical experience by implementing a simple Generative AI application using Python libraries like TensorFlow or PyTorch.

Unit 1	**8 Hours**

Introduction to Generative AI: What and why is Generative AI? , Definition and core principles of GAI, Traditional AI/ML vs. Generative AI, Differences between traditional AI (discriminative) and GAI (generative) approaches, How Generative AI Works, Content creation by models, integration into machine learning and development processes, Generative AI Workflows, Data requirements and evaluation metrics for generative models, Applications of GAI, Real-world applications across various industries.

Self-Study Content: Applications on traditional AI and Generative AI

Unit 2	**8 Hours**

Large Language Models: Transformer Architecture, Foundational aspects of transformer models in LLMs, Training Techniques for LLMs, Pre-training and fine-tuning methods, Case Studies of LLMs, Prominent LLMs like GPT-3, BERT, and their applications, Introduction to Multimodal Generative Models, Definition and processing of multimodal GAI models, Challenges and advantages of multimodal versus unimodal models, Applications like generating video descriptions, creating music from images, and interactive storytelling

Self-Study Content: Open sources on LLMs, Commercial LLMs

Unit 3	8 Hours
Generative Models: Generative Adversarial Networks (GANs): Fundamental concepts including generators, discriminators, and training processes, Types of GANs, Various GAN architectures like DCGAN, WGAN, and their functionalities, Variational Auto encoders (VAEs)**,** Role in probabilistic generative modelling and differences from GANs.	
Self-Study Content: Case studies on DCGAN,WGAN	
Unit 4	**8 Hours**
Prompt Engineering and Retrieval-Augmented Generation: Prompt Engineering, Effective prompts for achieving desired outputs from GAI models, Embedding Techniques, Types of embeddings (word, sentence) and their use in vector databases, Vector Databases, Importance in efficient retrieval and search operations for GAI applications, Retrieval-Augmented Generation (RAG) , Concept of RAG and enhancement of GAI model performance through vector databases	
Self-Study Content: Prompt Engineering Challenges, Challenges in RAG implementation and potential solutions	
Unit 5	**8 Hours**
Hands-on Python Implementation of GenAI Application, Essential Python Libraries for GAI: Libraries like TensorFlow, PyTorch, and other GAI frame works **Building a Simple Chatbot:** Development of a practical chatbot application using GAI techniques learned throughout the course, **Project Presentations:** Showcase of chatbot projects, fostering learning exchange and creative exploration	
Self-Study Content: Case studies on Real time examples	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics.	Bloom's Taxonomy Level	Level Indicator
CO1	**Summarize** the Introduction to Generative AI Generative AI.	Understand	L2
CO2	**Explore** Large Language Models and Generative Models.	Understand	L2
CO3	**Describe** Prompt Engineering and Retrieval-Augmented Generation.	Understand	L2
CO4	Gain practical experience by implementing Python over GenAI Application.	Apply	L4

Suggested Learning Resources:				
Textbooks:				
Sl. No	**Title**	**Author**	**Year & Edition**	**Publisher**
1	Introduction to Generative AI	Engler, Numa Dhamani,	Released November 2023	Manning Publication
2	Generative AI in Action	Amit Bahree	Released November 2023	Manning Publication
3	GANs in Action	Jakub Langr and Vladimir Bok	September 9, 2019 SBN13: 9781638354239	Manning Publication
4	Generative AI with Python and TensorFlow 2	Joseph Babcock, Raghav Bali	April 2021	Packt Publishing
Reference Books:				
1	Generative AI Defined: How it Works, Benefits and Dangers.	Hughes, O	August 7, 2023	TechRepublic
2	What Is Generative AI?	Kyle Stratis	Released December 2023	O'Reilly Media inc.,
3	Generative AI with LangChain.	Ben Auffarth	Released December 2023	Packt Publishing

Web links and Video Lectures (e-resources)

1. Introduction to Generative AI https://youtu.be/cZaNf2rA30k.
2. Introduction to large language models https://youtu.be/G2fqAlgmoPo
3. What is Retrieval-Augmented Generation (RAG)? https://youtu.be/T-D1OfcDW1M
4. Lawton, G. (2023, September) What is Generative AI? Everything you need to know, Enterprise AI

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar Presentation
3. Individual Role play/Team Demonstration
4. Case study

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**Summarize** the Introduction to Generative AI Generative AI	2											2	2		
CO2	**Explore** Large Language Models and Generative Models	2		1	1	1						1	2	2	2	
CO3	**Describe** Prompt Engineering and Retrieval-Augmented Generation	2	1	1		1						1	1	2	1	
CO4	**Gain** practical experience by implementing Python over GenAI Application	3	2	2	1	3				2		2	2	2	1	

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Social Network Analysis**		
Course Code: **P22CS7022**	CIE Marks: **50**	CIE Weightage:**50%**
Teaching hours/week (L:T:P): **3:0:0**	SEE Marks: **50**	SEE Weightage:**50%**
Teaching hours of Pedagogy:**40**	Exam Hours: **3 Hrs**	
Credits:**3**		

Course learning Objectives:

CLO1: To understand the concept of Social Network Analysis.
CLO2: To define Network centrality components like density, reachability, connectivity, and reciprocity
CLO3: To understand similarity and structural equivalence in SNA
CLO4: To understand two modes of networks in SNA
CLO5: To learn the visualization of social networks.

Unit 1	**8 Hours**

Introduction to the Semantic Web and Social Networks: The Semantic Web, Limitations of the current Web, The semantic solution, Development of the Semantic Web and the emergence of the social web.

Self-Study Content: Discussion: Case study on this topic covered in the syllabus: work on face book

Unit 2	**8 Hours**

Social Network Analysis: What is network analysis, Development of Social Network Analysis Key concepts and measures in network analysis, The global structure of networks, The macro-structure of social networks, Personal networks.

Self-Study Content: Google PageRank algorithm

Unit 3	**8 Hours**

Centrality and power : Centrality and centralization in SNA
Introduction: The several faces of power , Degree centrality, Degree: Freeman's approach, Closeness centrality, Closeness: Path distances, Closeness: Reach Closeness: Eigenvector of geodesic distances , Betweenness Centrality , Betweenness: Freeman's approach to binary relations

Self-Study Content: Degree: Bonacich's approach , Closeness: Hubbell, Katz, Taylor, Stephenson and Zelen influence **Discussion:** Case study on this topic covered in the syllabus: work on Twiiter

Unit 4	**8 Hours**

Two-mode networks for SNA
Understanding mode networks- Bi-partite data structures, visualizing two-mode data, quantitative analysis using two-mode Singular value decomposition (SVD) analysis two-mode factor analysis, two-mode correspondence analysis.

Self-Study Content: Discussion: Case study on this topic covered in the syllabus: work on Linkdin

Unit 5	8 Hours
VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS Visualization, Visualizing Online Social Networks, Node-Link Diagrams , Adjacency Matrix Representations and applications of Social Network Analysis.	
Self-Study Content: Online Advertising in Social Networks: Applications of Social Network Advertising.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics.	Bloom's Taxonomy Level	Level Indicator
CO1	**Design** and develop semantic web related applications	Apply	L3
CO2	**Understand** the fundamental concepts of social network analysis	Understand	L2
CO3	**Analyze** the centrality and centralization in SNA	Analyze	L4
CO4	**Ability** to represent two-mode networks in SNA	Apply	L3
CO5	**Learn** the Visualization of social networks	Remember	L1

Suggested Learning Resources:

Textbooks:

1	Social Networks and the Semantic Web	ISBN-13: 978-0-387-71000-6 e-ISBN-13: 978-0-387-71001-3	Peter Mika Peter Mika Yahoo! Research Barcelona Barcelona, Spain	Springer publication (Unit 1 and Unit 2)
2	Introduction to Social Network Methods	Robert A. Hanneman, Mark Riddle	Mark Riddle, University of California, 2005	[Published in digital form and available at http://faculty.ucr.edu/~hanneman/nettext/index.html] (Unit 3 and Unit 4)
3	Social Network Analysis for Startups	Finding connections on the social web ISBN 978-1-4419-7141-8 e-ISBN 978-1-4419-7142-5 (Unit 5)	2011	Maksim Tsvetovat, Alexander Kouznetsov

Reference Books:				
1.	Computational Social Networks Tools	Perspectives and Applications Ajith Abraham and Aboul-Ella Hassanien	-	-
2	Dion Goh and Schubert Foo	Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively	IGI Global Snippet, 2008	-
3	Statistical Analysis of Network Data with R: Eric D	Kolaczyk, Gábor Csárdi	Springer, 2014	-
4	Social Network Analysis	Methods and applications Stanley wasserman university of illinols katherine faust university of south carolina cambridge university press	-	-
Web links and Video Lectures (e-resources)				

- http://faculty.ucr.edu/~hanneman/nettext/index.html
- https://onlinecourses.nptel.ac.in/noc22_cs117/preview
- https://nptel.ac.in/courses/106106239
- https://www.coursera.org/learn/social-network-analysis
- https://visiblenetworklabs.com/guides/social-network-analysis-101/

CO- PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the fundamental concepts of social network analysis	3	2	2			2	2							1	
CO2	Analyze the centrality and centralization in SNA	1	3												1	
CO3	Understand the similarity and structural equivalence in SNA	2	1	3			2	2							2	
CO4	Analyze two-mode networks in SNA	3	1	2			2	2							1	
CO5	Visualize the social networks	2	1	3											2	

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: **Managing Big Data**		
Course Code: **P22CS7023**	CIE Marks:**50**	CIE Weightage:**50%**
Teaching hours/week (L:T:P): **3:0:0**	SEE Marks:**50**	SEE Weightage:**50%**
Teaching hours of Pedagogy:**40**	Exam Hours: **3 Hrs**	
Credits:**3**		

Course learning Objectives:

CLO1: Explore and apply the Big Data analytic techniques for business applications.
CLO2: Discuss the overview of Apache Hadoop.
CLO3: Able to implement basic technologies that forms the foundations of Big Data.

Unit 1	8 Hours

Introduction to Hadoop: Data! Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing.

Hadoop Distributed File system: The Design of HDFS, HDFS Concepts: Blocks, Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data.

Self-Study Content: Data Flow: Anatomy of a File Read, Anatomy of a File Write

Unit 2	8 Hours

YARN: Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness.

Developing a MapReduce Application: The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, writing a Unit Test with MR-Unit: Mapper, Reducer, Running Locally on Test Data, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, Job Control, Apache Oozie.

Self-Study Content: Writing a Unit Test with MR-Unit.

Unit 3	8 Hours

How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures : Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, Task Execution.

HIVE: The Hive Shell, An Example, Running Hive, Configuring Hive, Hive Services, The Meta store,

Comparison with Traditional Databases, Schema on Read Versus Schema on Write, Updates, Transactions, and Indexes, SQL-on-Hadoop Alternatives, Hive QL, Data Types, Operators and Functions, Tables, Managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables, Dropping Tables, Querying Data, Sorting and Aggregating, MapReduce Scripts, Joins, Sub queries, Views, User-Defined Functions, Writing a UDF, Writing a UDAF.
Self-Study Content: Examples for Writing and Reading Parquet Files Avro

Unit 4	**8 Hours**
PARAQUET: Data Model, Nested Encoding, Parquet File Format, Parquet Configuration, Writing and Reading Parquet Files Avro, Protocol Buffers, Thrift, Parquet MapReduce. **Spark:** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution	
Self-Study Content: Installing Spark.	

Unit 5	**8 Hours**
Sqoop: Getting Sqoop, Sqoop Connectors, A Sample Import, Text and Binary File Formats, Generated Code, Additional Serialization Systems, Imports: A Deeper Look, Controlling the Import, Imports and Consistency, Incremental Imports, Direct-Mode Imports, Working with Imported Data, Imported Data and Hive, Importing Large Objects, Performing an Export, Exports: A Deeper Look, Exports and Transnationality, Exports and Sequence Files. **Zookeeper**: An Example, Group Membership in Zookeeper, Creating the Group, Joining a Group, Listing Members in a Group, Deleting a Group, The Zookeeper Service, Data Model, Operations, Implementation, Consistency, Sessions, States, Building Applications with Zookeeper, A Configuration Service, The Resilient Zookeeper Application, A Lock Service, More Distributed Data Structures and Protocols, Zookeeper in Production, Resilience and Performance, Configuration.	
Self-Study Content: Installing and Running Zookeeper.	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics.	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Interpret** the architecture of big data systems and describe how HDFS manages distributed data storage and access	L2	Understand
CO2	**Apply** YARN and MapReduce concepts to build and run basic big data processing applications	L3	Apply
CO3	**Analyze** the execution of MapReduce jobs by developing, debugging, and optimizing applications to understand internal data flow and system behavior.	L4	Analyze

CO4	**Utilize** tools such as Parquet, Sqoop, Zookeeper, Hive, and Apache Spark to process and analyze large-scale datasets	L3	Apply & Analyze

Suggested Learning Resources:				
Textbooks:				
1.	**Title**	**Author**	**Year & Edition (Latest)**	**Publisher**
	Hadoop: The Definitive Guide	Tom White	Fourth Edition,2012	O'Reilley
Reference Books:				
1.	SPARK: The Definitive Guide	MateiZaharia and Bill Chambers	First Edition,2018	O'Reilley
2	Apache Flume: Distributed Log Collection for Hadoop	D'SouzaandSteve Hoffman	Second Edition,2014	O'Reilley
Web links and Video Lectures (e-resources)				
1. **https://www.tutorialspoint.com/big_data_tutorials.htm** 2. **https://www.digimat.in/nptel/courses/video/106104189/L01.html**				

CO- PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Interpret the architecture of big data systems and describe how HDFS manages distributed data storage and access	1				2									2	
CO2	Apply YARN and MapReduce concepts to build and run basic big data processing applications		2	1	1										2	
CO3	Analyze the execution of MapReduce jobs by developing, debugging, and optimizing applications to understand internal data flow and system behavior.			2		3				1					2	
CO4	Utilize tools such as Parquet, Sqoop, Zookeeper, Hive, and Apache Spark to process and analyze large-scale datasets			2	1	1									2	

Academic Year: **2025-26**	Semester: **VII**	Scheme: **P22**
Course Title: **Natural Language Processing**		
Course Code: **P22CS7024**	CIE Marks: **50**	CIE Weightage: **50%**
Teaching hours/week (L:T:P) **3:0:0**	SEE Marks: **50**	SEE Weightage: **50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3 hrs**	
Credits:**3**		
Prerequisite: Theory of Computation, Compiler Design		

Course learning Objectives:

CLO1: Understand the basic concepts and basic algorithms of Natural language processing.
CLO2: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers
CLO3: Ability to use existing natural language processing tools to conduct basic natural language processing, such as text normalization, or syntactic parsing.
CLO4: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

Unit 1	**8 Hours**

Overview and language Modelling :

Overview: Origins and Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications, Information Retrieval, Language Modelling, Various Grammar- based Language Models.

Self-Study Content: Statistical Language Model.

Unit 2	**8 Hours**

Word Level and Syntactic Analysis:

Word Level Analysis: Regular Expressions, Finite State-Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word Classes, Part of Speech Tagging.

Syntactic Analysis: Context Free Grammar, Constituency, Parsing

Self-Study Content: Probabilistic Parsing.

Unit 3	**8 Hours**

Semantic Analysis and Discourage Processing:

Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.

Discourage Processing: Cohesion, Reference Resolution

Self-Study Content: Discourse Coherence and Structure

Unit 4	8 Hours
Natural Language Generation and Machine Translation: **Natural Language Generation:** Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG. **Machine Translation:** Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches	
Self-Study Content: Translation Involving Indian Languages	
Unit 5	**8 Hours**
Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems, Information Retrieval Models, Classical Information Retrieval Models, Non-Classical Models of IR, Alternative Models of IR, Evaluation of the IR System. Lexical Resources: Word Net, Frame Net, Stemmers	
Self-Study Content: Part-of-Speech Tagger, Research Corpora	

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the fundamental concept of NLP, grammar-based language model and statistical-based language model.	Apply	L3
CO2	**Analyse** the different Natural language processing techniques	Analyze	L2
CO3	**Design** and develop an application using Natural Language Processing tools.	Design	L4

Suggested Learning Resources:

Textbooks:

1.	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U S Tiwary	1st Edition, 2008	Oxford University Press

Reference Books:

1.	Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	Daniel Jurafsky, James H Martin	2nd Edition 2008	Prentice Hall
2	Natural Language Understanding	James Allen	2nd Edition 1995	Benjamin Publishing Company

Web links and Video Lectures (e-resources)
1. Natural Language processing with python – Analyze text with the natural language toolkit **URL:** www.nltk.org/book_1e d/

CO-PO Mapping

CO	Statement	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**Understand** the fundamental concept of NLP, grammar-based language model and statistical-based language model.	3	3	3		1									2	
CO2	**Analyse** the different Natural language processing techniques	2	3	3		1									2	
CO3	**Design** and develop an application using Natural Language Processing tools.	2	3	2		1			2						2	

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Mobile Security**		
Course Code: **P22CS7031**	CIE Marks: **50**	CIE Weightage: **50%**
Teaching hours/week (L:T:P): **2:2:0**	SEE Marks: **50**	SEE Weightage: **50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3 Hrs**	
Credits: **3**		

Course learning Objectives:

CLO1: Analyze threats and vulnerabilities in mobile communication systems, including wireless environments and malware.
CLO2: Evaluate and apply security techniques to secure network and transport protocols used in mobile communications.
CLO3:Design secure mobile services, including m-Government and m-Commerce, with appropriate message protection and registry mechanisms.
CLO4: Implement countermeasures to secure multimedia communications on mobile networks, including watermarking techniques.
CLO5: Apply Android security practices in app development, including permissions, IPC mechanisms, and tools to prevent common vulnerabilities such as SQL injection.

Unit 1	**8 Hours**

Threats, Hacking, and Viruses in Mobile Communications: Introduction to Mobile Communications, Basics of Mobile Communications, Infrastructure less Networks, Wireless Vulnerabilities and Threats, Attacks in Mobile Environments, Mobile Malware, Prevention Techniques in Mobile Systems.

Self Study content: Intrusion Detection in Wireless Communications.

Unit 2	**8 Hours**

Common Techniques for Mobile Communications Security: Introduction, Securing Network Protocols, IPsec, TLS, and VPNs in Mobile Contexts, Attacks on Network/Transport Protocols, Transport Protocols Security, Public Key Infrastructure: Mobile PKI Applications and Functions, Wireless PKI.

Self Study content: Case Study on Mobile VPNs.

Unit 3	**8 Hours**

Securing Mobile Services: Introduction, Basics on E-Services, M-Services Discovery, Basic Examples of M-Services and Challenges, M-Government, M-Service Message Protection Mechanisms, Securing Registry for M-Services.

Self Study content : M-Commerce.

Unit4	**8 Hours**

Security of Multimedia Communications: Introduction, Transmission Issues of Mobile Multimedia, Securing Copyright in Mobile Networks, Major Watermarking Techniques, Attacks against Mobile Multimedia, Attacks Targeting Watermarking Schemes, Countermeasures against Watermarking Attacks.

Self Study content : Security of Mobile Multimedia Multicasting Schemes.	
Unit 5	**8 Hours**
Android Security: Development and Debugging on Android, Android's Securable IPC Mechanisms, Android's Security Model, Android Permissions Review, Intents, Activities, Broadcasts, Services, Content Providers, Tools for App Hardening: ProGuard, SafetyNet, Static/Dynamic Analysis	
Self Study content : Avoiding SQL Injection, Files and Preferences.	

Course Outcomes: On completion of this course, students are able to:	
COs	**Course Outcomes** with ***Action verbs*** for the Course topics.
CO1	**Analyze** mobile communication threats and recommend mitigation strategies.
CO2	**Apply** cryptographic and security protocols to protect mobile networks.
CO3	**Design** secure mobile services and evaluate associated privacy mechanisms.
CO4	**Assess** and implement multimedia content security including watermarking techniques.
CO5	**Develop** Android applications with security-conscious design, permissions, and practices.

Suggested Learning Resources:

Textbooks:

1	Security Of mobile Communications	Noureddine Boudriga	8th Edition, 2010	CRC Press
2	Mobile Application Security	Himanshu Dwivedi Chris Clark David Thiel	2010	McGraw-Hill

Reference Books:

1.	Practical Mobile Forensics	Satish Bommisetty, Rohit Tamma, Heather Mahalik	2020	Packt Publishing
2	Android Hacker's Handbook	Joshua J. Drake, Zach Lanier, Collin Mulliner, et al.	2014	Wiley

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Analyze mobile communication threats and recommend mitigation strategies.	2	1	2			1	1					1	1	1	
CO2	Apply cryptographic and security protocols to protect mobile networks.	2		2			1						1		1	
CO3	Design secure mobile services and evaluate associated privacy mechanisms.	2	1							1		2			1	
CO4	Assess and implement multimedia content security including watermarking techniques.	2		2									1		1	
CO5	Develop Android applications with security-conscious design, permissions, and practices.	2	2	1					1	1			1		1	

Academic Year: **2025-26**	Semester: **VII**	Scheme: **P22**
Course Title: **Embedded System And IOT**		
Course Code: **P22CS7032**	CIE Marks:**50**	CIE Weightage:**50%**
Teaching hours/week (L:T:P) **3:0:0**	SEE Marks: **50**	SEE Weightage:**50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3**	
Credits: **03**		
Prerequisite: Basic Electronics, C Programming		

Course learning Objectives:

CLO1: Introduce the fundamentals of embedded systems, including hardware and software components.
CLO2: Explain the communication mechanisms between devices and embedded systems using serial, parallel, and wireless communication.
CLO3: Teach device driver programming and interrupt handling mechanisms used in embedded applications.
CLO4: Provide an overview of the Internet of Things (IoT) and the architecture, technologies, and protocols that support it.
CLO5: Develop skills for prototyping and designing embedded software and hardware systems for IoT applications.

Unit 1	**8 Hours**

Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.
Text1: 1.1,1.2,1.3,1.4,1.5,1.8,1.9,1.10,1.11,1.12

Self-Study Content: Study case studies of embedded systems in real-time applications

Unit 2	**8 Hours**

Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, **Text1:3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10**

Self-Study Content: Study the structure and applications of CAN and PCI buses.

Unit 3	**8 Hours**

Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access,.
Programming Concepts and Embedded Programming in C: Software Programming in Assembly Language (ALP) and in High-Level Language 'C',C Program Elements: Header and Source Files and Pre processor Directives, Program Elements: Macros and Functions, Program Elements: Data Types, Data Structures, Modifiers, Statements, Loops and Pointers
Text1:4.1,4.2,4.3,4.5,4.7,4.8, ,5.1,5.2,5.3,5.4

Self-Study Content: Linux device drivers and explore basic Linux kernel module development.	
Unit4	**8 Hours**
Internet of Things: An Overview Internet of Things, IoT Conceptual Framework ,IoT Architectural View ,Technology Behind IoT, Sources of IoT,M2M Communication, Examples of IoT **Prototyping the Embedded Devices for loT and M2M:** Introduction, Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud **Text 2:1.1,1.2,1.3,1.4,1.5,1.6,1.7,8.1,8.2,8.3,8.4**	
Self-Study Content: Case studies on smart cities, agriculture, and healthcare using IoT.	
Unit 5	**8 Hours**
Design Principles for Web Connectivity: Introduction, Web Communication Protocols for Connected Devices **Prototyping and Designing the Software for IoT Applications:** Introduction, Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs **Text 2:3.1,3.2.9.1,9.2,9.3,9.4**	
Self-Study Content: Develop a simple cloud-connected project using NodeMCU and Blynk/ThingSpeak.	
Course Outcomes: On completion of this course, students are able to:	
CO1	**Apply** knowledge of the **fundamental components and their functionality** in **Embedded Systems** and the **Internet of Things (IoT)**
CO2	**Analyze the problem statement** and **recommend suitable devices and mechanisms.**
CO3	**Design** and prototype embedded hardware and software for IoT-based applications using real-world APIs and cloud services.

Suggested Learning Resources:

Textbooks:

	Title	Author	Year & Edition (Latest)	Publisher
1	Embedded Systems: Architecture, Programming, and Design	Raj Kamal	2nd / 3rd edition	Tata McGraw hill
2	Internet of Things-Architecture and Design Principles	Raj Kamal	2nd edition	McGraw Hill Education (India) Private Limited

Reference Books:

1.	The 8051 Microcontroller and Embedded Systems	Muhammad Ali Mazidi	second edition	Pearson Education
2.	Designing the Internet of Things	Adrian McEwen and Hakim Cassimally	3rd edition	Wiley

Web links and Video Lectures (e-resources)
1. https://nptel.ac.in/courses/108102045 2. https://nptel.ac.in/courses/117106114 3. https://nptel.ac.in/courses/106101163 4. https://nptel.ac.in/courses/106105166 5. https://nptel.ac.in/courses/108107211

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

CO-PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**Apply** knowledge of the fundamental components and their functionality in Embedded Systems and the Internet of Things (IoT)	2												2		
CO2	**Analyze** the problem statement and recommend suitable devices and mechanisms**.**	2	2	2											2	
CO3	**Design** and prototype embedded hardware and software for IoT-based applications using real-world APIs and cloud services.	1		3	2									1		3

Academic Year: **2025-26**	Semester: **VII**	Scheme: **P22**
Course Title: **High Performance Computing**		
Course Code: **P22CS7033**	CIE Marks: **50**	CIE Weightage: **50%**
Teaching hours/week (L:T:P): **3:0:0**	SEE Marks: **50**	SEE Weightage: **50%**
Teaching hours of Pedagogy: **40**	Exam Hours: **3 hrs**	
Credits: **3**		

Prerequisite:

1. Foundation in **Computer Architecture** (knowledge of CPU design, memory systems).
2. Basic understanding of **Operating Systems** (concepts of process, thread, synchronization).
3. Ability to write programs using in **C/C++ programming**.

Course learning Objectives:

CLO1: Understand the architecture and design principles of high-performance computing systems including memory hierarchy, multi-core and vector processors.
CLO2: Learn and apply shared memory parallel programming using POSIX threads (Pthreads).
CLO3: Understand the fundamentals of message-passing models and develop MPI-based applications.
CLO4: Explore GPU architectures and understand the fundamentals of CUDA programming.
CLO5: Optimizing CUDA applications with respect to memory, thread management, and execution performance.

Unit 1	**8 Hours**

Introduction to High–Performance Computers, Memory Hierarchy, CPU Design: Reduced Instruction Set Computers, Multiple–Core Processors, Vector Processors, Parallel Semantics, Distributed Memory Programming.

Self-Study Content: Memory Hierarchy and Its Impact on HPC Performance

Unit 2	**8 Hours**

Programming Shared Address Space Platforms: Thread Basics, Importance of Threads,The POSIX Thread API, Thread Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Designing Asynchronous Programs.

Self-Study Content: Thread Synchronization and Race Conditions in Pthreads

Unit 3	**8 Hours**

Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations.

Self-Study Content: Overlapping communication in MPI programming

Unit 4	8 Hours
Introduction: GPUs as Parallel Computers, Architecture of a Model GPU, Why More Speed or Parallelism? Parallel Programming Languages and Models, Overarching Goals. History of GPU Computing: Evolution of Graphics Pipelines, GPU Computing. Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer.	
Self-Study Content: Explore more advanced CUDA features like memory management and performance tuning.	
Unit 5	**8 Hours**
CUDA Threads: CUDA Thread Organization, Using blockIdx and threadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, Performance Considerations: More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfecting, Instruction Mix, Thread Granularity, Measured Performance and Summary.	
Self-Study Content: Hierarchy of CUDA memory types and their access speed and lifetime.	

COs	**Course Outcomes** with ***Action verbs*** for the Course topics
CO1	**Explain** the fundamental concepts and architecture of High Performance Computing (HPC) systems, including memory hierarchy, vector processors, and multi-core processors
CO2	**Apply** multi-threaded programming techniques using POAIX Threads (Pthreads) to Develop shared memory parallel applications
CO3	**Develop** message-passing programs using MPI to achieve parallelism in distributed memory systems.
CO4	**Analyze** the GPU architecture and programming models to determine suitability for data-parallel applications.
CO5	**Optimize** CUDA-based GPU applications by tuning thread management and memory usage for improved performance**.**

Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Rubin H Landau, Oregon State University, http://science.oregonstate.edu/ rubin/			
2	Introduction to parallel computing	Ananth Grama,Anshul Gupta,Vipin kumar, George Karypis	Pearson education publishers	Second edition
3	Programming Massively Parallel Processors – A Hands-on Approach	David B Kirk, Wen-mei W. Hwu	Elsevier and nvidia Publishers	First Edition, , 2010.
Reference Books				
1	Parallel Programming for Multicore and cluster systems	Thomas Rauber and Gudula Runger	Springer	International Edition, 2009 .
2	Parallel Programming in C with MPI and Open MP,	Michael J.Quin	McGraw Hill	4 th Edition
3	Computer Architecture: A quantitative Approach	Hennessey and Patterson	MorganKaufman Publishers	

Web links and Video Lectures(e-Resources):	
1	Rubin H Landau, Oregon State University, http://science.oregonstate.edu/ rubin/

CO-PO Mapping

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Explain the fundamental concepts and architecture of High Performance Computing (HPC) systems, including memory hierarchy, vector processors, and multi-core processors	2	2											1	2	
CO2	Apply multi-threaded programming techniques using POAIX Threads (Pthreads) to Develop shared memory parallel applications	2	2	2		2								2	2	
CO3	Develop message-passing programs using MPI to achieve parallelism in distributed memory systems.	2	2	2		2								2	2	
CO4	Analyze the GPU architecture and programming models to determine suitability for data-parallel applications.	2	3	2		2								2	2	
CO5	Optimize CUDA-based GPU applications by tuning thread management and memory usage for improved performance.	2	2	1		2								2	2	

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Fundamentals of Image Processing**		
Course Code: **P22CS7034**	CIE Marks:**50**	CIE Weightage:**50%**
Teaching hours/week (L:T:P): **3:0:0**	SEE Marks:**50**	SEE Weightage:**50%**
Teaching hours of Pedagogy:**40**	Exam Hours: **3 Hrs**	
Credits:**3**		

Course learning Objectives:

CLO1: Understand the fundamentals of digital image processing.
CLO2: Understand the image enhancement techniques used in digital image processing.
CLO3: Understand the image restoration techniques and methods used in digital image processing.
CLO4: Understand the morphological operations and algorithms.
CLO5: Understand various segmentation methods used in digital image processing.

Unit 1	**8 Hours**

Introduction: What Is Digital Image Processing? , The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.
Digital Imaging Fundamentals: Elements of Visual Perception, Image Sampling and Quantization, Some Basic Relationships between Pixels.

Self-Study Content: An Introduction to the Mathematical Tools Used in Digital Image Processing

Textbook Map:1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.4, 2.5

Unit 2	**8 Hours**

Intensity Transformations and Spatial Filtering: Background, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters.

Self-Study Content: Comprehend the local Histogram Processing techniques

Textbook Map:3.1, 3.2, 3.3, 3.4, 3.5

Unit 3	**8 Hours**

Image Restoration: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering.
Image Compression: Fundamentals, Some Basic Compression Methods- Huffman coding, Arithmetic coding, Run-Length coding.

Self-Study Content: Bit-Plane coding

Text Book:5.1, 5.2, 5.3, 8.1, 8.2 – 8.2.1, 8.2.3, 8.2.5

Unit 4	**8 Hours**

Color Image Processing: Color Fundamentals, Color Models.
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

Self-Study Content: Gray-Scale Morphology: Erosion and Dilation.

Textbook Map: 6.1, 6.2, 9.1, 9.2, 9.3, 9.4, 9.5	
Unit 5	**8 Hours**
Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Segmentation using Morphological Watersheds.	
Self-Study Content: The use of Motion in Segmentation: Spatial Techniques	
Textbook Map: 10.1, 10.2, 10.3, 10.4, 10.5	

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the fundamental principles, techniques, and applications of digital image processing.	L2	Understand
CO2	**Apply** image enhancement, restoration, filtering, and compression methods to solve basic image processing problems.	L3	Apply
CO3	**Analyse** techniques for Color image processing, morphological operations, and image segmentation to extract meaningful features.	L3	Analyse

Suggested Learning Resources:

Textbooks:

1	Digital Image Processing	Rafael C Gonzalez and Richard E. Woods	3e, 2010	PHI

Reference Books:

1.	Digital Image Processing	S. Jayaraman, S. Esakkirajan, T. Veerakumar	2014	TMH
2	Fundamentals of Digital Image Processing	A. K. Jain	2004	Pearson

Web links and Video Lectures (e-resources)

- https://www.udemy.com/course/image-processing-and-computer-vision-with-python-opencv/?couponCode=CP130525
- https://archive.nptel.ac.in/courses/108/103/108103174/
- https://youtu.be/ArKe6zMkXnk
- https://youtu.be/iZmHHVwp0Ow

CO-PO Mapping

CO's	Statements	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the fundamental principles, techniques, and applications of digital image processing.	3	2											3		
CO2	Apply image enhancement, restoration, filtering, and compression methods to solve basic image processing problems.	3	2	1											2	
CO3	Analyse techniques for Color image processing, morphological operations, and image segmentation to extract meaningful features.	3	2	1											2	

Academic Year: 2025-26	**Semester: VII**	**Scheme: P22**
Course Title: **Machine Learning (Integrated)**		
Course Code: **P22CS704**	CIE Marks: **50**	CIE Weightage:**50%**
Teaching hours/week (L:T:P): **3:0:2**	SEE Marks: **50**	SEE Weightage:**50%**
Teaching hours of Pedagogy:**40**	Exam Hours: **3 Hrs**	
Credits:**4**		

Course learning Objectives:

CLO1: To understand the fundamental concepts behind machine learning

CLO2: To be capable of defining machine learning problems for various applications.

CLO3: To have the capability to use machine learning algorithms to address problems of moderate difficulty.

Unit 1	**8 Hours**

Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.

Concept learning: Concept learning task, Concept learning as search, Find-S, Version Spaces and Candidate Elimination Algorithm.

Self-Study Content: Problems on Find –S algorithm and Candidate Elimination Algorithm

Textbook Map:	Text book 1- Chapter 2 Text book 2- Chapter 1
Laboratory Exercise:	Implementation of Find-S and Candidate Elimination algorithms

Unit 2	**8 Hours**

Decision Tree Learning: Introduction to Decision Tree Learning Model (Structure of a Decision Tree, Fundamentals of Entropy), Decision Tree Induction Algorithms (ID3 Tree Construction, C4.5 Construction, Classification and Regression Trees Construction, Regression Trees), Validating and Pruning of Decision Trees, Metrics for Evaluating classifier performance.

Self-Study Content: Problems on ID3 and C4.5

Textbook Map:	Text Book 2: Chapter 6
Laboratory Exercise:	Implementation of ID3 and C4.5 Algorithms

Unit 3	**8 Hours**

Artificial Neural Networks: Introduction, Biological Neurons, Artificial Neurons (Simple Model of an Artificial Neuron, Artificial Neural Network Structure, Activation Functions), Perceptron and Learning Theory (XOR Problem, Delta Learning Rule and Gradient Descent), Types of Artificial Neural Networks (Feed Forward Neural Network, Fully Connected Neural Network, Multi-Layer Perceptron (MLP), Feedback Neural Network), Learning in a Multi-Layer Perceptron, Radial Basis Function Neural Network, Applications, Advantages and Disadvantages, Challenges.

Self-Study Content: Self-Organising Feature map		
Text Book:	Text book 2: Chapter 10	
Laboratory Exercise:	Implementation of ANN	
Unit 4		**8 Hours**
Bayesian learning: Introduction, Bayes Theorem, Concept Learning, Maximum Likelihood and Least-Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.		
Self-Study Content: Problems on Naïve Bayes Classifier		
Textbook Map:	Text Book 1: Chapter 6	
Laboratory Exercise:	Implementation of Naïve Bayes Classifier	
Unit 5		**8 Hours**
Ensemble Learning: Introduction (Ensembling Techniques), Parallel Ensemble Models (Voting, Bootstrap Resampling, Bagging, Random Forest), Incremental Ensemble Models (Stacking, Cascading), Sequential Ensemble Models (AdaBoost). **Reinforcement Learning:** Introduction, The Learning task, Q Learning (Function, Algorithm, Example, Convergence, Experimentation strategies, Updating Sequence).		
Self-Study Content: Temporal Difference Learning		
Textbook Map:	Text book 1: Chapter 13 Text book 2: Chapter 12	
Laboratory Exercise:	Implementation of Random Forest and AdaBoost	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics.	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the fundamental concepts of machine learning	L2	Understand
CO2	**Analyse** the given problem and associate with suitable machine learning algorithms to solve it.	L3	Apply
CO3	**Implement** machine learning technique for given applications	L3	Apply

Suggested Learning Resources:				
Textbooks:				
1	Machine Learning	Tom M Mitchell,	2013	McGraw Hill
2	Machine Learning	S Sridhar and M Vijayalakshmi	2021	Oxford University Press India
Reference Books:				
1.	Hands-on Machine Learning with Scikit-Learn & TensorFlow	Aurelien Geron	2nd, 2019	O'Reilly Publication
2	Introduction to Machine Learning	Ethem Alpaydin	2nd ,2013	,PHI Learning Pvt. Ltd
Web links and Video Lectures (e-resources)				
• Introduction to Machine Learning ,NPTEL video - https://nptel.ac.in/courses/106106139				

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**Understand** the fundamental concepts of machine learning	3														
CO2	**Analyse** the given problem and associate with suitable machine learning algorithms to solve it.	3	3	3	1		1		1	1	1	1		2	2	
CO3	**Implement** various applications using suitable machine learning techniques.	3	3	3	1	3	1		2	2	2	2		2	2	1

MACHINE LEARNING (Integrated) – P22CS704 [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VII	
Laboratory Exercise	
1.	Apply and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. **(enjoySport Dataset)**
2.	For a given set of training data examples stored in a .CSV file **(enjoySport Dataset),** implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3.	Demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply the knowledge to classify a new sample**.(Play Tennis Dataset)**
4.	Demonstrate the working of the decision tree based CART algorithm. **(Play Tennis Dataset)**
5.	Apply Decision tree regression for a given dataset**.(Play_Tennis_reg Dataset)**
6.	Implement a Perceptron Algorithm for AND Logic Gate with 2-bit Binary Input. Test for different Hyper parameters.
7.	Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets. **(Iris Dataset)**
8.	Apply Naive Bayes Classifier to classify the text **.(spam Dataset)**
9.	Apply Random Forest for classification task on a given dataset**.(Iris Dataset)**
10.	Implement AdaBoost ensemble method on a given dataset**.(Iris Dataset)**