

DHANALAKSHMI SRINIVASAN INSTITUTE OF RESEARCH AND TECHNOLOGY

(Deemed to be University under section 3 of UGC Act, 1956.)
PERAMBALUR – 621 212, TAMIL NADU, INDIA.

SCHOOL OF ARTS AND SCIENCE

CURRICULUM AND SYLLABUS

M.Sc. COMPUTER SCIENCE

REGULATION 2026

PROGRAMME:

Vision:

To excel as a vibrant hub of computational excellence, cultivating brilliant researchers, expert programmers, and forward-thinking computer scientists who develop intelligent systems, drive digital innovation, and contribute meaningfully to technological and societal advancement.

Mission:

- To offer inclusive, flexible, and interdisciplinary postgraduate programs in computer science that integrate advanced algorithms, software systems, data science, and emerging technologies, preparing graduates with superior analytical, programming, and problem-solving abilities for diverse career paths and lifelong learning.
- To promote high-impact research and scholarly activities in artificial intelligence, machine learning, cybersecurity, networks, and computational theory, addressing critical challenges in industry, healthcare, education, and community services.
- To expand access to advanced computer science education for rural and underprivileged students by blending modern computing expertise with local needs, preserving cultural heritage through digital means, and fostering entrepreneurial skills for sustainable career opportunities.
- To nurture ethical values, social responsibility, and global awareness via rigorous projects, industry partnerships, community engagements, and experiential learning that bridge advanced theoretical knowledge with practical real-world computing applications.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO	PROGRAM EDUCATIONAL OBJECTIVES
PEO1	To provide graduates with profound knowledge in core and advanced computer science areas including algorithms, data structures, software engineering, artificial intelligence, and systems design, enabling successful careers in academia, research, and the IT Industry.
PEO2	To develop strong analytical, critical thinking, and research skills so that graduates can independently design, implement, and evaluate innovative computing solutions for complex real-life problems.
PEO3	To instill professional ethics, effective communication, teamwork, and leadership qualities that prepare graduates to collaborate in multidisciplinary teams and contribute responsibly to technological progress.
PEO4	To encourage lifelong learning and adaptability, empowering graduates to keep pace with rapid advancements in computer science and pursue research, higher studies, or entrepreneurial ventures in the field.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	PROGRAM SPECIFIC OUTCOMES
PSO1	Graduates will be proficient in applying advanced algorithms, programming paradigms, data analytics, and artificial intelligence techniques to develop efficient, scalable, and intelligent software systems and applications.
PSO2	Graduates will demonstrate expertise in computational research methodologies, cybersecurity practices, system optimization, and emerging tools, enabling them to contribute effectively to the IT industry, research organizations, and technology-driven community initiatives.

PROGRAM OUTCOMES (Pos)

PO	PROGRAM OUTCOMES
PO1	Disciplinary Knowledge Demonstrate comprehensive knowledge and understanding of the fundamental concepts, theories, principles, and applications in the chosen discipline and allied fields.
PO2	Critical Thinking and Problem Solving Identify, analyze, and solve complex academic, professional, and societal problems using logical reasoning, analytical skills, and evidence-based approaches.
PO3	Research and Inquiry Apply scientific methods, research techniques, and investigative skills to conduct studies, analyze data, interpret results, and draw meaningful conclusions.
PO4	Creativity and Innovation Develop innovative ideas, creative solutions, and entrepreneurial approaches to address contemporary challenges in academic, professional, and social contexts.
PO5	Digital and Technological Competence Utilize appropriate digital technologies, software tools, and information resources effectively and ethically for learning, research, communication, and problem-solving.
PO6	Environment and Sustainability Understand environmental issues and sustainable development goals and apply this knowledge to promote ecological balance and responsible resource utilization.
PO7	Ethics and Social Responsibility Demonstrate ethical values, integrity, inclusiveness, and social responsibility while contributing positively to society and professional environments.
PO8	Teamwork and Leadership Work effectively as an individual and as a member or leader of diverse and multidisciplinary teams, demonstrating leadership, collaboration, and interpersonal skills.
PO9	Communication Skills Communicate effectively through oral, written, visual, and digital means with diverse audiences in academic, professional, and societal settings.
PO10	Employability and Entrepreneurship Develop professional competencies, managerial abilities, and entrepreneurial skills required for employment, higher education, and self-employment opportunities.
PO11	Lifelong Learning Recognize the need for continuous learning, adaptability, and self-development to meet evolving personal, professional, and societal demands in a dynamic global environment.

SEMESTER-I

Semester	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
								CAT	ESE	Total
I	Core	Advanced Python Programming for Data Science	PCS26101	3	0	0	3	40	60	100
	Core	Advanced Python Programming Lab	PCS26102	0	0	4	2	40	60	100
	SEC	Research Methodology and Scientific Writing	PCS26S01	4	0	0	4	40	60	100
		Research Tools and Applications Lab	PCS26S02	0	0	4	2	40	60	100
	MDC	Multi- Disciplinary Course – I		3	0	0	3	40	60	100
	DEC	Cloud Computing	PCS26001	4	0	0	4	40	60	100
		Cyber Security	PCS26002							
		Advanced Database Management Systems	PCS26003							
	DEC	Data Visualization and Business Intelligence	PCS26004	4	0	0	4	40	60	100
		Artificial Intelligence for Data Science	PCS26005							
		Parallel Computing	PCS26006							
							22			700

SEMESTER-II

Semester	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
								CAT	ESE	Total
II	Core	Machine Learning Techniques	PCS26203	3	0	0	3	40	60	100
	Core	Machine Learning Lab	PCS26204	0	0	4	2	40	60	100
	SEC	Mobile Application Development	PCS26S03	4	0	0	4	40	60	100
		Mobile Application Development Lab	PCS26S04	0	0	4	2	40	60	100
	MDC	Multi- Disciplinary Course - II		3	0	0	3	40	60	100
	DEC	Digital Image Processing	PCS26007	3	0	2	4	40	60	100
		Blockchain Technology	PCS26008							
		Internet of Things (IoT)	PCS26009							
	DEC	Cyber Security and Digital Forensics	PCS26010	4	0	0	4	40	60	100
		Computer Vision and Pattern Recognition	PCS26011							
		Edge Computing and Intelligent Systems	PCS26012							
							22			700

SEMESTER-III

Semester	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
								CAT	ESE	Total
III	Core	Deep Learning and Neural Networks	PCS26305	3	0	0	3	40	60	100
	Core	Deep Learning Lab	PCS26306	0	0	4	2	40	60	100
	Core	Natural Language Processing	PCS26307	3	0	0	3	40	60	100
	Core	NLP and Text Analytics Lab	PCS26308	0	0	4	2	40	60	100
	Core	Green Computing	PCS26309	4	0	0	4	40	60	100
	DEC	Full Stack Web Development	PCS26013	3	0	2	4	40	60	100
		Quantum Computing	PCS26014							
		Software Testing and Quality Assurance	PCS26015							
	SEC	Communication and Soft Skill	-	1	0	0	1	40	60	100
	EE	Experiential Elective (Internship)	PCSEE01	*	0	0	2	*	*	100
							21			800

SEMESTER-IV

Semester	Course Category	Title of the Course	Course Code	L	T	P	Credits	Marks		
								CAT	ESE	Total
IV	Core	Hadoop and Big Data Analytics	PCS26410	4	0	0	3	40	60	100
	Core	Hadoop and Big Data Analytics Lab	PCS26411	0	0	4	2	40	60	100
	Core	Data Engineering and Apache Spark	PCS26412	4	0	0	4	40	60	100
	Core	Project	PCS26413	0	0	24	12	40	60	100
							21			400

MDC offered to other Department

1. PCS26901 - Artificial Intelligence for Interdisciplinary Applications
2. PCS26902 - Digital Transformation and Emerging Technologies

DEC offered by the Department

1. PCS26001 - Cloud Computing
2. PCS26002 - Cyber Security
3. PCS26003 - Advanced Database Management Systems
4. PCS26004 - Data Visualization and Business Intelligence
5. PCS26005 - Artificial Intelligence for Data Science
6. PCS26006 - Parallel Computing
7. PCS26007 - Digital Image Processing
8. PCS26008 - Blockchain Technology
9. PCS26009 - Internet of Things (IoT)
10. PCS26010 - Cyber Security and Digital Forensics
11. PCS26011 - Computer Vision and Pattern Recognition
12. PCS26012 - Edge Computing and Intelligent Systems
13. PCS26013 - Full Stack Web Development
14. PCS26014 - Quantum Computing
15. PCS26015 - Software Testing and Quality Assurance

Semester-wise Categorization of Courses

COURSE CATEGORY	Semester				No of Courses	Total Credits
	I	II	III	IV		
Core Courses (Theory & Practical)	2	2	5	4	13	45
SEC–Skill Enhancement Course	2	2	1	-	5	13
MDC–Multi Disciplinary Course	1	1	-	-	2	6
DEC–Disciplinary Elective Course	2	2	1	-	5	20
EE–Experiential Elective	-	-	1	-	1	2
Total Courses Per Semester	7	7	8	4	26 (Courses)	
Total Credits	22	22	21	21	86 (Credits)	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26101	Advanced Python Programming for Data Science	Core	3	0	0	3
Pre-Requisite: Basic knowledge of Python Programming, Statistics, Database Management Systems, and Data Analytics.							
Co- Requisite: Machine Learning and Data Visualization.							
Progressive Course: Artificial Intelligence, Deep Learning, Big Data Analytics, Natural Language Processing, and Predictive Analytics.							
Course Objectives:							
1	Understand advanced Python programming concepts and their applications in data science.						
2	Acquire knowledge of Python libraries for data manipulation, visualization, statistical analysis, and machine learning.						
3	Apply advanced programming techniques to process, analyze, and model complex datasets.						
4	Develop efficient data science applications using Python frameworks and analytical tools.						
5	Evaluate machine learning models and data-driven solutions using Python-based data science ecosystems.						
Course Outcomes:							
CO1: Explain advanced Python programming concepts, libraries, and development environments for data science applications. (K2)							
CO2: Apply Python libraries to perform data preprocessing, visualization, and exploratory data analysis on structured and unstructured datasets. (K3)							
CO3: Analyze datasets using statistical methods and machine learning algorithms implemented in Python. (K4)							
CO4: Evaluate predictive models using appropriate performance metrics and optimization techniques in Python. (K5)							
CO5: Design end-to-end data science applications using advanced Python frameworks and modern analytical tools. (K6)							
Unit-I	Advanced Python Programming Fundamentals						9 Hrs.
Advanced Python Features – Object-Oriented Programming – Functional Programming – Iterators and Generators – Decorators – Lambda Functions – Exception Handling – File Handling – Regular Expressions – Virtual Environments – Package Management – Python Development Tools.							

Unit-II	Data Processing and Visualization using Python	9 Hrs.
NumPy Arrays – Pandas DataFrames – Data Cleaning – Data Transformation – Missing Value Handling – Exploratory Data Analysis (EDA) – Data Aggregation – Matplotlib – Seaborn – Plotly – Statistical Visualization.		
Unit-III	Statistical Computing and Machine Learning	9 Hrs.
Descriptive Statistics – Probability Distributions – Hypothesis Testing – Feature Engineering – Scikit-learn Framework – Regression – Classification – Clustering – Model Selection – Cross Validation – Performance Evaluation.		
Unit-IV	Advanced Data Science Applications	9 Hrs.
Time Series Analysis – Text Processing – Natural Language Processing Basics – Data Pipelines – APIs for Data Collection – Web Scraping – Data Integration – Model Deployment – Streamlit – Flask – FastAPI.		
Unit-V	Emerging Trends in Python for Data Science	9 Hrs.
Deep Learning using TensorFlow and Keras – PyTorch Basics – Big Data Processing with PySpark – Cloud-based Data Science – MLOps Concepts – Explainable AI (XAI) – Model Monitoring – Responsible AI – Future Trends in Python Data Science.		

Text Book(s):

1. Wes McKinney, Python for Data Analysis, 3rd Edition, O'Reilly Media, 2022.
2. Jake VanderPlas, Python Data Science Handbook, 2nd Edition, O'Reilly Media.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly Media.
4. Joel Grus, Data Science from Scratch, 2nd Edition, O'Reilly Media.
5. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media.

Reference Book(s):

1. Al Sweigart, Automate the Boring Stuff with Python, 2nd Edition, No Starch Press.
2. Allen B. Downey, Think Python, 2nd Edition, O'Reilly Media.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.
4. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning, Springer.
5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.

E- Resources

1. Python Documentation – <https://docs.python.org/3/>
2. NumPy Documentation – <https://numpy.org/doc/>
3. Pandas Documentation – <https://pandas.pydata.org/docs/>
4. Scikit-learn Documentation – <https://scikit-learn.org/stable/>
5. Kaggle Learn – <https://www.kaggle.com/learn>

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26101			Advanced Python Programming for Data Science								3		3
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50
CO2	3	3	3	2	3	–	–	–	2	–	–	3	3	2.75
CO3	3	3	3	3	3	–	–	–	2	–	–	3	3	2.88
CO4	2	3	2	3	3	2	–	–	2	2	–	3	3	2.50
CO5	3	3	3	3	3	2	2	–	3	2	–	3	3	2.69
	2.8	2.8	2.6	2.75	3.0	2.0	2.0	–	2.25	2.0	–	3.0	2.8	2.66

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26102	Advanced Python Programming Lab	Core Course	0	0	4	2

Pre-Requisite: Basic knowledge of Python programming.

Co- Requisite: Data Science Fundamentals.

Progressive Course: Machine Learning and Deep Learning.

Course Objectives:

- 1 Develop advanced programming skills using Python for data analysis.
- 2 Apply statistical and analytical techniques to structured and unstructured data.
- 3 Perform data preprocessing, transformation, and visualization using Python libraries.
- 4 Implement machine learning algorithms using Python libraries for predictive analysis.
- 5 Develop data-driven solutions for real-world data science problems.

Course Outcomes:

CO1: Design Python programs for advanced data analysis tasks. (K6)

CO2: Apply NumPy and Pandas libraries for large-scale data manipulation and analysis. (K3)

CO3: Perform exploratory data analysis and statistical modeling to interpret datasets. (K4)

CO4: Create professional data visualizations using Python libraries such as Matplotlib and Seaborn. (K6)

CO5: Implement and Evaluate machine learning algorithms for predictive analytics using Scikit-Learn. (K5)

List of Programs

60 Hrs.

1. Design and implement a data loading and exploratory data analysis (EDA) solution using Pandas for a real-world dataset. **(6 Hrs)**
2. Implement data preprocessing techniques to handle missing values, duplicate records, and inconsistent data in a real-world dataset. **(6 Hrs)**
3. Develop numerical and statistical computing applications using NumPy arrays for scientific data analysis. **(6 Hrs)**
4. Perform data manipulation, aggregation, filtering, and transformation using Pandas DataFrame operations on real-world datasets. **(6 Hrs)**
5. Analyze datasets by computing descriptive statistical measures such as mean, median, mode, variance, and standard deviation. **(6 Hrs)**

6. Design informative data visualizations using Matplotlib for effective presentation of analytical results.
(6 Hrs)
7. Develop statistical visualizations using Seaborn to perform exploratory data analysis on real-world datasets.
(6 Hrs)
8. Analyze relationships among variables by performing correlation and covariance analysis on real-world datasets. (6 Hrs)
9. Implement and evaluate a Linear Regression model using Scikit-Learn for predictive analytics. (6 Hrs)
10. Design and implement a Logistic Regression model for binary classification using real-world datasets.
(6 Hrs)

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26102			Advanced Python Programming Lab								4		2
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	—	3	—	—	—	—	—	—	3	3	2.67
CO2	3	3	2	2	3	—	—	—	—	—	—	3	3	2.71
CO3	2	3	3	3	3	—	—	—	2	—	—	3	3	2.75
CO4	3	3	2	3	3	—	—	—	2	—	—	3	3	2.75
CO5	3	3	3	3	3	2	—	—	2	—	—	3	3	2.78
	2.8	2.8	2.4	2.75	3.0	2.0	—	—	2.0	—	—	3.0	3.0	2.73

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26S01	Research Methodology and Scientific Writing	SEC	4	0	0	4
Pre-Requisite: Basic understanding of academic writing and computer applications.							
Co- Requisite: Statistical Methods for Research.							
Progressive Course: Dissertation/Research Project.							
Course Objectives:							
1. Introduce the fundamentals of research and scientific investigation.							
2. Familiarize students with various research methodologies and research designs.							
3. Develop skills in literature review, data collection, and data analysis.							
4. Train students in scientific, technical, and academic writing.							
5. Inculcate research ethics, publication standards, and intellectual property awareness.							
Course Outcomes:							
CO1: Explain the concepts, objectives, processes, and types of research. (K2)							
CO2: Apply appropriate research methodologies and research designs for scientific investigations. (K3)							
CO3: Analyze literature, identify research gaps, and formulate research problems and hypotheses. (K4)							
CO4: Analyze and Interpret research data using appropriate statistical and analytical techniques. (K4)							
CO5: Prepare research papers, dissertations, and technical reports by adhering to research ethics and publication standards. (K6)							
Unit-I	Foundations of Research						12 Hrs.
Research: Meaning, Objectives, Types of Research – Basic, Applied and Interdisciplinary Research – Research Process – Identification and Formulation of Research Problems – Research Questions and Hypotheses – Research Design – Characteristics of Good Research.							
Unit-II	Literature Review and Research Design						12 Hrs.
Literature Survey – Sources of Literature – Digital Libraries and Databases – Review Techniques – Research Gap Identification – Experimental, Descriptive and Analytical Research Designs – Sampling Methods – Questionnaire Design.							
Unit-III	Data Collection and Analysis						12 Hrs.
Primary and Secondary Data – Methods of Data Collection – Observation, Interviews, Surveys and Case Studies – Data Preparation – Data Coding and Classification – Descriptive Statistics – Introduction to Statistical Software Tools.							

Unit-IV	Scientific Writing and Publication	12 Hrs.
Technical Report Writing – Structure of Research Paper – Abstract Writing – Citation Styles (APA, IEEE, MLA) – Referencing Tools – Writing Journal Articles, Conference Papers and Book Chapters – Manuscript Preparation and Submission Process.		
Unit-V	Research Ethics and Emerging Trends	12 Hrs.
Research Integrity – Plagiarism and Plagiarism Detection Tools – Intellectual Property Rights (IPR) – Copyrights, Patents and Trademarks – Open Access Publishing – Predatory Journals – Research Metrics (h-index, Impact Factor, CiteScore, SNIP, SJR) – Emerging Trends in Computing Research.		

Text Book(s):

1. Research Methodology: Methods and Techniques – C.R. Kothari & Gaurav Garg, New Age International Publishers.
2. Research Methodology – Ranjit Kumar, Sage Publications.
3. The Craft of Research – University of Chicago Press.
4. Scientific Writing and Communication – Oxford University Press.
5. Practical Research: Planning and Design – Pearson Education.

Reference Book(s):

1. Research Design: Qualitative, Quantitative and Mixed Methods Approaches – Sage Publications.
2. Doing Your Research Project – McGraw-Hill Education.
3. How to Write and Publish a Scientific Paper – Cambridge University Press.
4. The Essential Guide to Doing Research – Sage Publications.
5. An Introduction to Statistical Learning – Springer.

e Resources:

1. Shodhganga – Indian ETD Repository
2. INFLIBNET Centre
3. Google Scholar
4. IEEE Xplore Digital Library
5. Directory of Open Access Journals (DOAJ)

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course							Hours				Credit
I	PCS26S01		Research Methodology and Scientific Writing							4				4
Course Outcomes (COs)	Programme Outcomes(POs)									Programme Specific Outcomes (PSOs)				Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	—	3	—	—	—	—	—	—	3	3	2.80
CO2	3	3	2	2	3	—	—	—	—	—	—	3	3	2.80
CO3	2	3	3	3	3	—	—	—	2	—	—	3	3	2.40
CO4	3	3	2	3	3	—	—	—	2	—	—	3	3	2.75
CO5	3	3	3	3	3	2	—	—	2	—	—	3	3	3.00
	2.8	2.8	2.4	2.7	3.0	2.0	—	—	2.0	—	—	3.0	3.0	2.63

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26S02	Research Tools and Applications Lab	SEC	0	0	4	2
Pre-Requisite: Basic knowledge of computer applications and research fundamentals.							
Co- Requisite: Research Methodology and Scientific Writing.							
Progressive Course: Research Project and Dissertation.							
Course Objectives:							
1. To familiarize students with modern research tools, software, and digital research platforms.							
2. To develop students' skills in literature search, reference management, plagiarism detection, and citation management.							
3. To enable students to analyze, interpret, and visualize research data using statistical and analytical tools.							
4. To train students to prepare scientific documents, research manuscripts, and publications using professional writing tools and standard formatting guidelines.							
5. To enhance students' research productivity by applying digital research resources, publication standards, and ethical research practices.							
Course Outcomes:							
CO1: Utilize digital research tools to perform literature surveys and identify research problems effectively. (K3)							
CO2: Manage references, citations, and bibliographies using research management software. (K3)							
CO3: Apply statistical and analytical tools to process, analyze, and visualize research data. (K3)							
CO4: Prepare scientific documents and research manuscripts following standard formatting and publication guidelines. (K6)							
CO5: Evaluate research quality, publication metrics, ethical practices, and journal standards for scholarly communication. (K5)							
Lis of Programs						60 Hrs.	
1. Perform an advanced literature search using Google Scholar and identify relevant research articles in a selected research domain. (6 Hrs)							
2. Demonstrate the creation and management of a personal research library using Mendeley Reference Manager. (6 Hrs)							
3. Organize and generate citations and bibliographies using Zotero for scholarly publications. (6 Hrs)							
4. Analyze citation metrics and author profiles using Google Scholar Profiles for research evaluation. (6 Hrs)							
5. Perform literature search, retrieval, and publication analysis using the IEEE Xplore Digital Library. (6 Hrs)							

6. Analyze research publications to identify research gaps through systematic literature review (SLR) techniques. **(6 Hrs)**
7. Develop a research dataset by collecting, organizing, and preprocessing data using Microsoft Excel. **(6 Hrs)**
8. Perform descriptive statistical analysis using SPSS, R, or Python for research data interpretation. **(6 Hrs)**
9. Evaluate research manuscripts using plagiarism detection software and interpret the generated similarity report. **(6 Hrs)**
10. Prepare a research manuscript by applying IEEE journal formatting guidelines. **(6 Hrs)**

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26S02			Research Tools and Applications Lab								4		2
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	–	3	–	–	–	–	–	–	3	3	2.67
CO2	3	3	2	2	3	–	–	–	–	–	–	3	3	2.71
CO3	2	3	3	3	3	–	–	–	2	–	–	3	3	2.75
CO4	3	3	2	3	3	–	–	–	2	–	–	3	3	2.75
CO5	3	3	3	3	3	2	–	–	2	–	–	3	3	2.78
	2.8	2.8	2.4	2.75	3.0	2.0	–	–	2.0	–	–	3.0	3.0	2.73

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26001	Cloud Computing	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Computer Fundamentals, Operating Systems, and Computer Networks.							
Co- Requisite: Programming Fundamentals and Web Technologies.							
Progressive Course: Advanced Cloud Computing, DevOps, Big Data Analytics, Cloud Security, and IoT.							
Course Objectives:							
1. Understand the fundamental concepts, characteristics, and architecture of cloud computing.							
2. Acquire knowledge of virtualization technologies, cloud service models, and deployment models.							
3. Explore cloud platforms, cloud storage systems, and resource management techniques.							
4. Understand cloud security, privacy, governance, and compliance requirements in cloud environments.							
5. Develop skills to design, deploy, and manage cloud-based applications using modern cloud platforms.							
Course Outcomes:							
CO1: Explain the concepts, characteristics, service models, and deployment models of cloud computing. (K2)							
CO2: Analyze virtualization technologies, cloud infrastructure components, and resource provisioning mechanisms. (K4)							
CO3: Apply cloud storage models, distributed storage systems, and resource management techniques in cloud environments. (K3)							
CO4: Design and deploy cloud-based applications using cloud platforms, microservices, and DevOps practices. (K6)							
CO5: Evaluate cloud security, privacy, governance, and compliance frameworks for secure cloud computing environments. (K5)							
Unit-I	Fundamentals of Cloud Computing						12 Hrs.
Evolution of Computing – Distributed Computing – Grid Computing – Utility Computing – Cloud Computing: Definition and Characteristics – Cloud Service Models (IaaS, PaaS, SaaS) – Cloud Deployment Models (Public, Private, Hybrid, Community Clouds) – Benefits and Challenges of Cloud Computing.							

Unit-II	Virtualization and Cloud Infrastructure	12 Hrs.
Virtualization Concepts – Hypervisors – Virtual Machines – Server Virtualization – Storage Virtualization – Network Virtualization – Containerization – Resource Provisioning – Data Center Architecture.		
Unit-III	Cloud Platforms and Storage Systems	12 Hrs.
Cloud Platforms: AWS, Microsoft Azure and Google Cloud Platform – Cloud Storage Models – Distributed File Systems – Object Storage – Block Storage – Cloud Databases – Data Management in Cloud Environments.		
Unit-IV	Cloud Application Development	12 Hrs.
Service-Oriented Architecture (SOA) – Web Services – APIs – Microservices Architecture – Cloud Application Development – DevOps Concepts – Continuous Integration and Continuous Deployment (CI/CD).		
Unit-V	Cloud Security and Governance	12 Hrs.
Cloud Security Challenges – Identity and Access Management – Authentication and Authorization – Data Security and Privacy – Risk Management – Compliance Standards – Governance Frameworks.		

Text Book(s):

1. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill Education.
2. Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Cloud Computing: Concepts, Technology and Architecture, Pearson Education.
3. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers.
4. Barrie Sosinsky, Cloud Computing Bible, Wiley Publications.
5. George Reese, Cloud Application Architectures, O'Reilly Media.

Reference Book(s):

1. Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies, Wiley Publications.
2. Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann Publishers.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.
4. Ronald L. Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley Publications.

e Resources:
1.Amazon Web Services Training and Certification
2.Microsoft Learn – Azure Fundamentals
3.Google Cloud Skills Boost

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| e Resources: |
| 1.Amazon Web Services Training and Certification |
| 2.Microsoft Learn – Azure Fundamentals |
| 3.Google Cloud Skills Boost |

Relationship Matrix for COs, POs and PSOs

[illegible]

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26002	Cyber Security	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of computer networks and operating systems.							
Co- Requisite: Computer Networks.							
Progressive Course: Ethical Hacking and Digital Forensics.							
Course Objectives:							
1.Understand the fundamental concepts of cybersecurity, information security, and security frameworks.							
2. Acquire knowledge of cryptographic techniques, network security mechanisms, and secure communication practices.							
3. Analyze cyber threats, vulnerabilities, attacks, and appropriate defense mechanisms.							
4. Develop skills to perform digital forensic investigations and incident response procedures.							
5. Understand cyber laws, ethical practices, privacy issues, and emerging trends in cybersecurity.							
Course Outcomes:							
CO1: Explain the principles, concepts, and practices of cybersecurity and information security. (K2)							
CO2: Apply cryptographic techniques and network security mechanisms to protect information assets and communication systems. (K3)							
CO3: Analyze cyber threats, vulnerabilities, attacks, and security risks to recommend appropriate defense mechanisms. (K4)							
CO4: Perform digital forensic investigations and incident response activities using standard forensic tools and techniques. (K3)							
CO5: Evaluate legal, ethical, privacy, and emerging cybersecurity issues to ensure secure and compliant computing environments. (K5)							
Unit-I	Introduction to Cyber Security						12 Hrs.
Information Security Concepts – Security Goals (Confidentiality, Integrity and Availability) – Threats and Vulnerabilities – Risk Management – Security Policies and Standards – Cyber Security Frameworks.							

Unit-II	Cryptography and Network Security	12 Hrs.
Symmetric Key Cryptography – Asymmetric Key Cryptography – Hash Functions – Digital Signatures – Public Key Infrastructure – Firewalls – Virtual Private Networks – Wireless Security.		
Unit-III	Cyber Threats and Ethical Hacking	12 Hrs.
Cyber Attacks and Threat Landscape – Social Engineering – Phishing Attacks – Password Attacks – Web Application Security – Vulnerability Assessment – Penetration Testing Concepts.		
Unit-IV	Malware Analysis and Digital Forensics	12 Hrs.
Types of Malware – Virus, Worm, Trojan Horse, Ransomware and Spyware – Incident Response Process – Digital Evidence Collection – Computer Forensics – Network Forensics – Forensic Tools and Techniques.		
Unit-V	Cyber Laws and Emerging Trends	12 Hrs.
Information Technology Act 2000 – Cyber Crimes and Legal Issues – Cyber Ethics – Privacy and Data Protection – Cloud Security – Internet of Things Security – Artificial Intelligence in Cyber Security.		

Text Book(s):

1. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publications.
2. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education.
3. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, Cengage Learning.
4. Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, Pearson Education.
5. James Graham, Richard Howard and Ryan Olson, Cyber Security Essentials, CRC Press.

Reference Book(s):

1. Matt Bishop, Computer Security: Art and Science, Addison-Wesley.
2. Eric Maiwald, Fundamentals of Network Security, McGraw-Hill Education.
3. Joseph Migga Kizza, Guide to Computer Network Security, Springer Publications.
4. Mark Stamp, Information Security: Principles and Practice, Wiley Publications.

e Resources:

1. Cybersecurity and Infrastructure Security Agency (CISA)
2. National Institute of Standards and Technology (NIST) Cybersecurity Resources
3. OWASP Foundation
4. NPTEL Cyber Security Courses

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26002			Cyber Security								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	2	3	-	-	2	-	-	2	3	3	2.20
CO2	3	3	2	1	3	-	-	-	-	-	2	3	3	2.00
CO3	3	3	3	2	3	-	-	-	-	-	3	3	3	2.30
CO4	3	3	3	3	3	1	-	-	1	1	3	3	3	2.31
CO5	2	3	2	3	2	3	2	3	1	2	3	2	3	2.38
	2.8	2.8	2.4	2.20	2.8	2.0	2.0	2.50	1.00	1.50	2.60	2.80	3.00	2.24

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26003	Advanced Database Management Systems	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Database Management Systems, SQL, and relational database concepts.							
Co- Requisite: Database Administration and Advanced SQL Programming concepts.							
Progressive Course: Big Data Analytics, Data Warehousing and Mining, and Distributed Database Systems.							
Course Objectives:							
1.Understand the advanced concepts, architectures, and design methodologies of database management systems.							
2. Acquire knowledge of transaction processing, concurrency control, and database administration techniques.							
3. Explore distributed database systems, NoSQL databases, and big data management technologies.							
4. Understand database security models, access control mechanisms, and recovery techniques.							
5. Develop skills to design, administer, optimize, and manage advanced database systems.							
Course Outcomes:							
CO1: Explain advanced database concepts, architectures, and database design methodologies. (K2)							
CO2: Analyze transaction processing, concurrency control mechanisms, and recovery protocols in database systems. (K4)							
CO3: Design and implement distributed and NoSQL database systems to address real-world data management requirements. (K6)							
CO4: Apply database security models, access control mechanisms, backup strategies, and recovery techniques in database environments. (K3)							
CO5: Evaluate emerging trends, challenges, and advanced technologies in modern database management systems. (K5)							
Unit-I	Advanced Database Concepts						12 Hrs.
Database Architecture – Data Models – Database Design Methodologies – Advanced SQL Queries – Views – Indexing Techniques – Stored Procedures – Triggers – Database Administration.							

Unit-II	Transaction Processing and Concurrency Control	12 Hrs.
Transaction Concepts – ACID Properties – Schedules and Serializability – Concurrency Control Techniques – Lock-Based Protocols – Timestamp Protocols – Deadlock Detection and Recovery.		
Unit-III	Distributed Database Systems	12 Hrs.
Distributed Database Concepts – Data Fragmentation – Data Replication – Distributed Query Processing – Distributed Transactions – Two-Phase Commit Protocol – Distributed Database Security.		
Unit-IV	NoSQL Databases and Big Data Management	12 Hrs.
Introduction to NoSQL Databases – Key-Value Databases – Document-Oriented Databases – Column-Family Databases – Graph Databases – Big Data Storage Systems – Database Scalability.		
Unit-V	Database Security and Recovery	12 Hrs.
Database Security Models – Access Control Mechanisms – Data Encryption – Backup Strategies – Recovery Techniques – Database Auditing – Emerging Trends in Database Systems.		

Text Book(s):

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw-Hill Education.
2. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education.
3. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill Education.
4. Carlos Coronel and Steven Morris, Database Systems: Design, Implementation and Management, Cengage Learning.
5. Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widom, Database Systems: The Complete Book, Pearson Education.

Reference Book(s):

1. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos and Richard T. Snodgrass, Advanced Database Systems, Morgan Kaufmann Publishers.
2. Thomas Connolly and Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management, Pearson Education.
3. C.J. Date, An Introduction to Database Systems, Addison-Wesley.
4. Pramod J. Sadalage and Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley.
5. Ted Hills, NoSQL and SQL Data Modeling: Bringing Together Data, Semantics and Software, Technics Publications.

e Resources:

1. Oracle Database Documentation
2. MySQL Documentation
3. PostgreSQL Documentation

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26003			Advanced Database Management Systems								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	2	3	-	-	2	-	-	2	3	3	2.20
CO2	3	3	3	2	2	-	-	-	-	-	2	3	3	2.33
CO3	3	3	3	3	3	-	-	-	-	-	3	3	3	2.67
CO4	3	3	3	3	3	2	1	1	-	-	3	3	3	2.50
CO5	2	3	2	3	2	3	2	2	1	1	3	2	3	2.23
	2.8	2.8	2.60	2.60	2.6	2.5	1.5	1.67	1.00	1.50	2.60	2.80	3.00	2.39

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26004	Data Visualization and Business Intelligence	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Database Management Systems, Statistics, and Spreadsheets.							
Co- Requisite: Programming Fundamentals and Data Analytics.							
Progressive Course: Big Data Analytics, Data Mining, Machine Learning, Artificial Intelligence, and Data Science.							
Course Objectives:							
1	Understand the principles, techniques, and applications of data visualization and business intelligence.						
2	Acquire knowledge of data preparation, transformation, and visualization techniques for effective decision-making.						
3	Apply business intelligence tools to analyze, interpret, and present business data.						
4	Develop dashboards and interactive reports using modern data visualization platforms.						
5	Evaluate business performance through analytical models and data-driven decision-making.						
Course Outcomes:							
CO1: Explain the concepts, architecture, and applications of data visualization and business intelligence. (K2)							
CO2: Apply data preparation, transformation, and visualization techniques using business intelligence tools. (K3)							
CO3: Analyze business data using dashboards, reports, and visualization methods for decision support. (K4)							
CO4: Evaluate business performance using key performance indicators (KPIs), business analytics, and visualization models. (K5)							
CO5: Design interactive dashboards and business intelligence solutions for organizational decision-making. (K6)							
Unit-I	Fundamentals of Data Visualization and Business Intelligence						12 Hrs.
Introduction to Business Intelligence – Evolution and Architecture of BI – Decision Support Systems – Data Warehousing Concepts – Business Analytics – Types of Analytics (Descriptive, Diagnostic, Predictive, Prescriptive) – Principles of Data Visualization – Visualization Design and Best Practices.							

Unit-II	Data Preparation and Visualization Techniques	12 Hrs.
Data Sources – Data Collection – Data Cleaning – Data Integration – Data Transformation – Data Modeling – Exploratory Data Analysis – Charts and Graphs – Statistical Visualization – Geographic Visualization – Storytelling with Data.		
Unit-III	Business Intelligence Tools and Dashboard Development	12 Hrs.
Introduction to Microsoft Power BI – Tableau – Google Looker Studio – Data Import and Transformation – Report Creation – Dashboard Design – Interactive Visualizations – Filters, Slicers, Drill-down, Drill-through – KPI Dashboards.		
Unit-IV	Business Analytics and Performance Measurement	12 Hrs.
Key Performance Indicators (KPIs) – Business Metrics – OLAP Concepts – Business Reporting – Financial Analytics – Sales Analytics – Customer Analytics – Supply Chain Analytics – Data-Driven Decision Making.		
Unit-V	Emerging Trends in Business Intelligence	12 Hrs.
Artificial Intelligence in Business Intelligence – Predictive Analytics – Self-Service BI – Cloud Business Intelligence – Real-Time Analytics – Big Data Visualization – Mobile BI – Data Governance – Data Security and Privacy – Future Trends in BI.		

Text Book(s):

1. Stephen Few, Information Dashboard Design, 2nd Edition, Analytics Press.
2. Cole Nussbaumer Knafl, Storytelling with Data, Wiley.
3. Ramesh Sharda, Dursun Delen, and Efraim Turban, Business Intelligence, Analytics, and Data Science: A Managerial Perspective, Pearson.
4. Alberto Cairo, The Truthful Art: Data, Charts, and Maps for Communication, New Riders.
5. Andy Kirk, Data Visualisation: A Handbook for Data Driven Design, Sage Publications.

Reference Book(s):

1. Ben Fry, Visualizing Data, O'Reilly Media.
2. Edward R. Tufte, The Visual Display of Quantitative Information, Graphics Press.
3. Giorgia Lupi and Stefanie Posavec, Dear Data, Princeton Architectural Press.
4. Cindi Howson, Successful Business Intelligence, McGraw-Hill.
5. David Loshin, Business Intelligence: The Savvy Manager's Guide, Morgan Kaufmann.

e Resources:

1. Microsoft Learn – Power BI Documentation – <https://learn.microsoft.com/power-bi/>
2. Tableau Learning – <https://www.tableau.com/learn>
3. Google Looker Studio – <https://lookerstudio.google.com>
4. Kaggle Datasets – <https://www.kaggle.com/datasets>
5. Our World in Data – <https://ourworldindata.org>

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course										Hours		Credit
I	PCS26004		Data Visualization and Business Intelligence										4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50	
CO2	3	3	2	2	3	–	–	–	2	–	–	3	3	2.63	
CO3	2	3	3	3	3	–	–	–	2	–	–	3	3	2.75	
CO4	2	3	3	3	3	2	–	–	3	2	–	3	3	2.70	
CO5	3	3	3	3	3	2	2	–	3	2	–	3	3	2.69	
	2.6	2.8	2.6	2.75	3.0	2.0	2.0	–	2.5	2.0	–	3.0	2.8	2.65	

Unit-III	AI Techniques and Predictive Analytics	12 Hrs.
Decision Trees – Random Forest – Support Vector Machine – Naïve Bayes – K-Means Clustering – Ensemble Learning – Model Evaluation – Cross Validation – Confusion Matrix – ROC Curve – Predictive Analytics.		
Unit-IV	Deep Learning and AI Frameworks	12 Hrs.
Artificial Neural Networks – Deep Learning Concepts – Convolutional Neural Networks (CNN) – Recurrent Neural Networks (RNN) – Transfer Learning – TensorFlow – Keras – PyTorch – AI Model Deployment.		
Unit-V	AI Ethics and Emerging Applications	12 Hrs.
Responsible AI – Explainable AI (XAI) – AI Ethics – Bias and Fairness – Privacy and Security – Generative AI – Large Language Models (LLMs) – AI for Healthcare – Finance – Smart Cities – Future Trends in AI.		

Text Book(s):

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, 3rd Edition, O'Reilly Media.
3. Ethem Alpaydin, Introduction to Machine Learning, 4th Edition, MIT Press.
4. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media.
5. Joel Grus, Data Science from Scratch, 2nd Edition, O'Reilly Media.

Reference Book(s):

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
4. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, Springer.
5. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann.

e Resources:

1. TensorFlow Documentation – <https://www.tensorflow.org>
2. PyTorch Documentation – <https://pytorch.org>
3. Scikit-learn Documentation – <https://scikit-learn.org>

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26005			Artificial Intelligence for Data Science								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11			PSO1
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50
CO2	3	3	3	2	3	–	–	–	2	–	–	3	3	2.75
CO3	3	3	3	3	3	–	–	–	2	–	–	3	3	2.88
CO4	2	3	2	3	3	3	2	–	2	2	–	3	3	2.55
CO5	3	3	3	3	3	3	2	–	3	2	2	3	3	2.77
	2.8	2.8	2.6	2.75	3.0	3.0	2.0	–	2.25	2.0	2.0	3.0	2.8	2.69

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26006	Parallel Computing	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Computer Organization, Operating Systems, Programming, and Data Structures.							
Co- Requisite: Advanced Programming and Computer Architecture.							
Progressive Course: High Performance Computing, Distributed Computing, Cloud Computing, GPU Computing, and Big Data Analytics.							
Course Objectives:							
1. Understand the principles, architectures, and programming paradigms of parallel computing.							
2. Acquire knowledge of parallel algorithms, performance metrics, and synchronization techniques.							
3. Apply parallel programming models to solve computationally intensive problems.							
4. Develop efficient parallel applications using shared-memory and distributed-memory programming frameworks.							
5. Evaluate the performance, scalability, and efficiency of parallel computing systems.							
Course Outcomes:							
CO1: Explain the concepts, architectures, and programming models of parallel computing. (K2)							
CO2: Apply parallel programming techniques using shared-memory and distributed-memory environments. (K3)							
CO3: Analyze parallel algorithms, synchronization mechanisms, and communication models for computational problems. (K4)							
CO4: Evaluate the performance, scalability, and efficiency of parallel computing systems using appropriate metrics. (K5)							
CO5: Design optimized parallel applications using modern parallel programming frameworks and architectures. (K6)							
Unit-I	Fundamentals of Parallel Computing						15 Hrs.
Introduction to Parallel Computing – Evolution of Parallel Systems – Flynn's Classification – Parallel Processing Concepts – Levels of Parallelism – Performance Metrics – Speedup – Efficiency – Scalability – Amdahl's Law – Gustafson's Law.							
Unit-II	Parallel Computer Architectures						15 Hrs.
Shared Memory Architecture – Distributed Memory Architecture – Multicore Processors – Many-core Systems – SIMD and MIMD Architectures – Cluster Computing – GPU Architecture – Memory Hierarchy – Interconnection Networks.							

Unit-III	Parallel Programming Models	15 Hrs.
Threads and Processes – Synchronization Mechanisms – Mutex – Semaphore – Barrier Synchronization – Message Passing Interface (MPI) – OpenMP Programming – Parallel Loop Constructs – Data and Task Parallelism – Load Balancing.		
Unit-IV	Parallel Algorithms and Performance Analysis	15 Hrs.
Parallel Sorting Algorithms – Parallel Matrix Multiplication – Parallel Graph Algorithms – Divide and Conquer Algorithms – Communication Overhead – Deadlock – Performance Evaluation – Benchmarking – Profiling and Optimization.		
Unit-V	High Performance and Emerging Parallel Computing	15 Hrs.
High Performance Computing (HPC) – GPU Computing using CUDA – Hybrid Parallel Programming – Cloud-based Parallel Computing – Big Data Processing Frameworks – Parallel File Systems – Fault Tolerance – Energy-Efficient Computing – Emerging Trends in Parallel Computing.		

Text Book(s):

1. Michael J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw-Hill.
2. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing, 2nd Edition, Addison-Wesley.
3. Peter S. Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann.
4. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.
5. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill.

Reference Book(s):

1. Barry Wilkinson and Michael Allen, Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, Pearson.
2. David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, Morgan Kaufmann.
3. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
4. Jack Dongarra, Ian Foster, Geoffrey Fox, William Gropp, Kenneth Kennedy, Linda Torczon, and Andy White, Sourcebook of Parallel Computing, Morgan Kaufmann.
5. Michael McCool, James Reinders, and Arch Robison, Structured Parallel Programming, Elsevier.

e Resources:

1. OpenMP Official Documentation – <https://www.openmp.org>
2. MPI Forum – <https://www.mpi-forum.org>
3. NVIDIA CUDA Documentation – <https://developer.nvidia.com/cuda-zone>

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course										Hours		Credit
I	PCS26006		Parallel Computing										4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50	
CO2	3	3	3	2	3	–	–	–	2	–	–	3	3	2.75	
CO3	3	3	3	3	3	–	–	–	2	–	–	3	3	2.88	
CO4	2	3	2	3	3	2	–	–	2	2	–	3	3	2.50	
CO5	3	3	3	3	3	2	2	–	3	2	–	3	3	2.69	
	2.8	2.8	2.6	2.75	3.0	2.0	2.0	–	2.25	2.0	–	3.0	2.8	2.66	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26203	Machine Learning Techniques	Core Course	3	0	0	3
Pre-Requisite: Basic knowledge of programming, probability, statistics, and linear algebra.							
Co- Requisite: Machine Learning Lab for practical implementation and evaluation of machine learning algorithms.							
Progressive Course: Advanced Machine Learning, Deep Learning, Natural Language Processing, and Intelligent Systems.							
Course Objectives:							
1. To explain the fundamental concepts, principles, and paradigms of Machine Learning.							
2. To demonstrate supervised and unsupervised learning algorithms for predictive and analytical tasks.							
3. To evaluate machine learning models using appropriate validation, performance, and optimization techniques.							
4. To apply machine learning algorithms to solve real-world data-driven problems.							
5. To analyze advanced machine learning and deep learning techniques for intelligent applications.							
Course Outcomes:							
CO1: Explain the fundamentals, paradigms, and applications of Machine Learning. (K2)							
CO2: Apply supervised learning algorithms for classification and prediction problems. (K3)							
CO3: Implement unsupervised learning techniques for data analysis and knowledge discovery. (K3)							
CO4: Evaluate and optimize machine learning models using appropriate performance metrics and validation techniques. (K5)							
CO5: Analyze advanced machine learning and deep learning models for solving real-world applications. (K4)							
Unit-I	Introduction to Machine Learning						15 Hrs.
Introduction to Machine Learning – Types of Learning: Supervised, Unsupervised, Semi-Supervised and Reinforcement Learning – Machine Learning Process – Data Preprocessing – Feature Engineering – Feature Selection – Model Selection – Applications of Machine Learning.							
Unit-II	Supervised Learning						15 Hrs.
Linear Regression – Logistic Regression – Decision Trees – Naïve Bayes Classifier – k-Nearest Neighbour Algorithm – Support Vector Machines – Ensemble Learning – Random Forests – Classification and Prediction Models.							

Unit-III	Unsupervised Learning	15 Hrs.
Clustering Techniques – K-Means Clustering – Hierarchical Clustering – Density-Based Clustering – Dimensionality Reduction – Principal Component Analysis (PCA) – Association Rule Mining – Applications of Unsupervised Learning.		
Unit-IV	Model Evaluation and Optimization	15 Hrs.
Training and Testing Datasets – Cross Validation – Bias and Variance – Performance Evaluation Metrics – Confusion Matrix – Precision, Recall and F1 Score – ROC Curve – Hypothesis Testing – Model Selection and Optimization Techniques.		
Unit-V	Advanced Machine Learning and Deep Learning	15 Hrs.
Artificial Neural Networks – Multi-Layer Perceptron – Deep Learning Concepts – Convolutional Neural Networks – Recurrent Neural Networks – Reinforcement Learning Fundamentals – Applications in Computer Vision, Natural Language Processing and Predictive Analytics.		

Text Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.
4. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
5. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, O'Reilly Media.

Reference Book(s):

1. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, Springer.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press.
3. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, Foundations of Machine Learning, MIT Press.
4. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.
5. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.

e Resources:

1. NPTEL – Machine Learning Courses
2. Coursera Machine Learning Specialization
3. TensorFlow Learning Resources
4. Scikit-Learn Documentation
5. Kaggle Learn Machine Learning

Relationship Matrix for COs, POs and PSOs

Semester	Course code	Title of the course										Hours		Credit
II	PCS26203	Machine Learning Techniques										3		3
Course Outcomes (COs)	Programme Outcomes(POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	3	3	3	3	2	1	1	-	-	3	3	3	2.20
CO2	3	3	3	3	3	1	1	2	1	1	3	3	3	2.33
CO3	3	3	3	3	3	2	1	1	-	-	3	3	3	2.67
CO4	3	3	3	3	2	1	-	1	-	-	2	3	3	2.50
CO5	3	3	3	3	3	1	1	2	1	1	3	3	3	2.23
	3.0	3.0	3.00	3.00	2.8	1.4	0.8	1.40	0.40	0.40	2.80	3.00	3.00	2.17

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26204	Machine Learning Lab	Core Course	0	0	4	2
Pre-Requisite: Basic knowledge of Python programming, statistics, and linear algebra.							
Co- Requisite: Machine Learning theory course covering supervised and unsupervised learning techniques, model evaluation, and predictive analytics.							
Progressive Course: Advanced Machine Learning, Deep Learning, Natural Language Processing, and Artificial Intelligence applications.							
Course Objectives:							
1. To provide practical exposure to machine learning concepts, techniques, and Python-based tools and frameworks.							
2. To develop skills in data preprocessing, exploratory data analysis, visualization, and feature engineering.							
3. To implement supervised and unsupervised machine learning algorithms for real-world applications.							
4. To evaluate machine learning models using appropriate validation techniques and performance metrics.							
5. To design and develop machine learning solutions for data-driven decision-making.							
Course Outcomes:							
CO1: Perform data preprocessing, exploratory data analysis, and visualization using machine learning tools and libraries. (K3)							
CO2: Implement supervised learning algorithms for classification and regression problems. (K3)							
CO3: Apply unsupervised learning techniques for clustering and pattern discovery. (K3)							
CO4: Evaluate machine learning models using suitable validation techniques and performance measures. (K5)							
CO5: Develop machine learning applications for solving real-world problems using standard datasets. (K6)							
List of Programs							60 Hrs.
1. Perform data preprocessing and data cleaning on a given dataset using Python libraries such as Pandas and NumPy.							
2. Perform exploratory data analysis and visualize data using Pandas, Matplotlib, and Seaborn.							
3.Implement a Simple Linear Regression model for predictive analysis using Scikit-learn.							

4. Implement and evaluate a Multiple Linear Regression model using appropriate performance metrics.
5. Implement and evaluate a Logistic Regression model for binary classification problems.
6. Implement the K-Nearest Neighbour (KNN) algorithm for classification and analyze its performance.
7. Construct and evaluate a Decision Tree Classifier for classification tasks.
8. Implement the Naïve Bayes Classification algorithm for a given dataset and interpret the results.
9. Implement and evaluate a Support Vector Machine (SVM) model for classification tasks.
10. Implement and analyze a Random Forest Classification model and determine feature importance.

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course										Hours		Credit
II	PCS26204		Machine Learning Lab										4		2
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	3	3	3	3	1	1	2	1	1	3	3	3	2.31	
CO2	3	3	3	3	3	1	1	1	1	1	3	3	3	2.23	
CO3	3	3	3	3	3	1	1	2	1	1	3	3	3	2.31	
CO4	3	3	2	3	3	1	-	1	-	-	2	3	3	1.92	
CO5	3	3	3	3	3	1	1	1	1	1	3	3	3	2.23	
	3.0	3.0	2.80	3.00	3.0	1.0	0.8	1.40	0.80	0.80	2.80	3.00	3.00	2.20	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26S03	Mobile Application Development	SEC	4	0	0	4
Pre-Requisite: Basic knowledge of programming concepts, object-oriented programming, and Java.							
Co- Requisite: Mobile Application Development Lab.							
Progressive Course: Advanced Android Development, Cross-Platform Mobile Development, and Mobile Computing.							
Course Objectives:							
1. To explain the architecture, evolution, development framework, and core concepts of the Android operating system and mobile application development.							
2. To develop Android applications using Android Studio, activities, intents, resources, and application lifecycle management techniques.							
3. To design interactive and responsive user interfaces using layouts, fragments, widgets, adapters, and custom views.							
4. To implement local databases and content providers for efficient data storage, retrieval, and sharing in Android applications.							
5. To create optimized Android applications by integrating multimedia, device features, multiple screen-size support, and application deployment techniques.							
Course Outcomes:							
CO1: Explain the Android architecture, SDK components, development framework, and mobile application development concepts. (K2)							
CO2: Build Android applications by implementing activities, intents, resources, and application lifecycle management techniques. (K3)							
CO3: Design responsive and user-friendly interfaces using layouts, fragments, widgets, adapters, and custom views. (K6)							
CO4: Develop Android applications that utilize SQLite databases, content providers, menus, notifications, and dialog components. (K3)							
CO5: Create, optimize, test, sign, and publish Android applications incorporating multimedia features, camera access, messaging services, and support for diverse screen sizes. (K6)							
Unit-I	Android Introduction						12 Hrs.
An Open Platform for Mobile Development – Native Android applications – Android SDK features – Evolution-development of android for mobile – Development framework.							

Unit-II	Android Application Development	12 Hrs.
Installation – Creating application – Types of Applications – Android development tools. Creating Applications and activities: Application Manifest file – Manifest editor – Externalizing the resources – Android application life cycle – Android application class- android activities.		
Unit-III	Building User Interfaces	12 Hrs.
Fundamental UI Design – Layouts – Fragments – Widget Tool box – Creating new views – introducing adapters.		
Unit-IV	Databases And Content Providers	12 Hrs.
Android databases – working with SQLite databases – Creating content providers – Native android content providers - Introducing the Action Bar – Creating and Using Menus and Action bar action items – Introducing Dialogs – Introducing notifications.		
Unit-V	Supporting And Optimizing For Different Screen Sizes	12 Hrs.
Creating scalable graphic assets – Working with animations-Audio, Video and using the Camera - introducing SMS and MMS – signing and publishing application.		

Text Book(s):

1. Reto Meier, “Professional Android 4 Application Development”, WROX Publication –Wiley – India, 2012
2. Pradeep Kothari & Kogent Learning Solutions Inc, “Android Application Development 3. Black Book”, Dreamtech Press, Edition 2014, ISBN: 978 – 93 – 5119 – 409 –5.
3. W. Frank Ableson, RobiSen, Chris King, C. Enrique Ortiz, “Android in Action”, Manning 5. Publications Co, Third Edition, ISBN 9781617290508
4. Lauren Darcey, Shane Conder, “SAMS Teach Yourself Android Application Development in 24 Hours”, Second edition.
5. Android Studio Development Essentials – Payload Media Publications.

Reference Book(s):

1. Professional Android Application Development – Reto Meier, Wrox Publications, Latest Edition.
2. Android Programming: The Big Nerd Ranch Guide – Big Nerd Ranch Guides, Latest Edition.
3. Android Application Development for Java Programmers – Cengage Learning.
4. Head First Android Development – O'Reilly Media, Latest Edition.
5. Learning Android – O'Reilly Media.

e Resources:

1. <https://developer.android.com/guide/>
2. Android Open Source Project (AOSP) Documentation.
3. Google Android Training and Certification Resources.
4. Kotlin Android Development Documentation.
5. Android Codelabs and Practical Tutorials.

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
II	PCS26S03			Mobile Application Development								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	3	3	3	3	-	-	-	1	-	2	3	3	2.23
CO2	3	3	2	2	3	-	-	-	1	-	3	3	3	2.15
CO3	2	3	3	2	3	-	-	-	1	1	3	3	3	2.15
CO4	3	3	3	3	3	-	-	-	1	-	2	3	3	2.23
CO5	3	3	3	3	3	1	-	-	2	2	3	3	3	2.46
	2.8	3.0	2.80	2.60	3.0	0.2	0	0	1.20	0.60	2.60	3.00	3.00	2.24

4. Write an application that draws basic graphical primitives on the screen. **(6 Hrs.)**
5. Develop an application that makes use of database. **(6 Hrs.)**
6. Implement an application that implements multi-threading. **(6 Hrs.)**
7. Develop a native application that uses GPS location information . **(6 Hrs.)**
8. Implement an application that writes data to the SD card . **(6 Hrs.)**
9. Implement an application that creates an alert upon receiving a message. **(6 Hrs.)**
10. Write a mobile application that creates alarm clock. **(6 Hrs.)**

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
II	PCS26S04			Mobile Application Development Lab								4		2
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	3	3	3	3	1	-	-	2	1	3	3	3	2.31
CO2	3	3	3	3	3	-	-	-	1	-	3	3	3	2.31
CO3	3	3	3	3	3	-	-	-	1	-	3	3	3	2.31
CO4	3	3	3	2	3	1	-	-	1	-	2	3	3	2.00
CO5	3	3	3	3	3	1	-	-	2	1	3	3	3	2.31
	3.0	3.0	3.00	2.80	3.0	0.6	0	0	1.40	0.40	2.80	3.00	3.00	2.25

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26007	Digital Image Processing	DEC	3	0	2	4
Pre-Requisite: Basic knowledge of mathematics, programming, and linear algebra concepts.							
Co- Requisite: Computer Vision and Pattern Recognition concepts.							
Progressive Course: Computer Vision, Medical Image Analysis, and Deep Learning for Image Processing.							
Course Objectives:							
1. To explain the fundamentals of digital image acquisition, representation, and processing.							
2. To demonstrate image enhancement, restoration, and filtering techniques for improving image quality.							
3. To analyze image segmentation and feature extraction methods for image interpretation.							
4. To evaluate image compression and pattern recognition techniques for efficient image analysis.							
5. To design digital image processing solutions for real-world applications using modern image processing techniques.							
Course Outcomes:							
CO1: Explain the principles and concepts of digital image processing and image representation. (K2)							
CO2: Apply image enhancement and restoration techniques to improve image quality. (K3)							
CO3: Analyze image segmentation and feature extraction methods for image interpretation. (K4)							
CO4: Evaluate image compression techniques and pattern recognition approaches. (K5)							
CO5: Design digital image processing solutions for applications in healthcare, biometrics, remote sensing, and computer vision. (K6)							
Unit-I	Fundamentals of Digital Image Processing						15 Hrs.
Introduction to Digital Images – Image Acquisition Systems – Sampling and Quantization – Pixel Relationships – Image Representation – Human Visual System – Color Models – RGB, CMY, HSV and YCbCr Models – Image File Formats – Applications of Digital Image Processing.							
Unit-II	Image Enhancement and Restoration						15 Hrs.
Spatial Domain Processing – Gray Level Transformations – Histogram Equalization – Contrast Stretching – Smoothing and Sharpening Filters – Frequency Domain Processing – Fourier Transform – Low Pass and High Pass Filtering – Noise Models – Image Restoration – Inverse Filtering – Wiener Filtering.							

Unit-III	Segmentation, Feature Extraction and Applications	15 Hrs.
Morphological Operations – Edge Detection – Thresholding – Region-Based Segmentation – Feature Extraction (Shape, Texture, Color Features) – Principal Component Analysis (PCA) – Image Compression (Lossless and Lossy Techniques, JPEG, JPEG2000) – Pattern Recognition – Face Recognition – Medical Image Processing – Computer Vision Applications – Deep Learning for Image Processing.		
Unit-IV	Digital Image Processing Laboratory	7 Hrs.
<ol style="list-style-type: none"> 1. Perform image acquisition and basic image manipulation using OpenCV/MATLAB/Python. 2. Implement image enhancement techniques using histogram equalization and contrast stretching. 3. Perform image filtering using smoothing and sharpening filters. 4. Implement Fourier Transform for frequency domain image processing. 5. Perform image restoration using noise removal and Wiener filtering. 6. Implement edge detection using Sobel, Prewitt, Roberts, and Canny operators. 		
Unit-V	Advanced Image Processing Laboratory	8 Hrs.
<ol style="list-style-type: none"> 1. Implement morphological operations such as dilation, erosion, opening, and closing. 2. Extract image features based on shape, texture, and color. 3. Implement image compression using JPEG techniques. 4. Develop a face recognition system using OpenCV. 5. Implement object detection using pre-trained deep learning models. 6. Develop a mini project for a real-world image processing application such as medical image analysis, biometric authentication, remote sensing, or intelligent surveillance. 		

Text Book(s):

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, 4th Edition, Pearson Education, 2018.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall India.
3. S. Jayaraman, S. Esakkirajan and T. Veerakumar, *Digital Image Processing*, McGraw Hill Education.
4. Wilhelm Burger and Mark J. Burge, *Principles of Digital Image Processing: Fundamental Techniques*, Springer.
5. Maria Petrou and Costas Petrou, *Image Processing: The Fundamentals*, Wiley.

Reference Book(s):

1. John C. Russ, *The Image Processing Handbook*, CRC Press.
2. Kenneth R. Castleman, *Digital Image Processing*, Pearson Education.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, *Image Processing, Analysis and Machine Vision*, Cengage Learning.
4. Mark Nixon and Alberto Aguado, *Feature Extraction and Image Processing for Computer Vision*, Academic Press.
5. Ramesh Jain, Rangachar Kasturi and Brian G. Schunck, *Machine Vision*, McGraw Hill.

e Resources:

1. NPTEL – Digital Image Processing Courses – <https://nptel.ac.in>
2. MIT OpenCourseWare – Image Processing – <https://ocw.mit.edu>
3. OpenCV Documentation – <https://docs.opencv.org>
4. MATLAB Image Processing Toolbox Documentation – <https://www.mathworks.com/help/images>
5. Coursera – Image and Video Processing Courses – <https://www.coursera.org>

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
II	PCS26007			Digital Image Processing								5		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11			PSO1
CO1	3	2	1	2	2	1	1	1	1	1	2	3	2	1.69
CO2	3	3	2	2	3	1	1	1	1	1	3	3	3	2.08
CO3	3	3	3	2	3	1	1	1	1	1	3	3	3	2.15
CO4	3	3	2	3	3	2	1	1	1	2	3	3	3	2.31
CO5	3	3	3	3	3	2	2	2	1	2	3	3	3	2.54
	3.0	2.8	2.20	2.40	2.8	1.4	1.2	1.20	1.00	1.40	2.80	3.00	2.80	2.15

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26008	Blockchain Technology	DEC	3	0	2	4
Pre-Requisite: Basic knowledge of computer networks, databases, and cryptography concepts.							
Co- Requisite: Cyber Security and Cryptography for secure communication and information protection.							
Progressive Course: Advanced Blockchain Development, Decentralized Applications (DApps), and Web 3.0 Technologies.							
Course Objectives:							
1. Explain the fundamental concepts and architecture of Blockchain technology.							
2. Describe cryptographic principles, distributed ledger systems, and consensus mechanisms.							
3. Analyze blockchain platforms, smart contracts, and decentralized applications.							
4. Develop blockchain-based solutions for various industrial sectors.							
5. Evaluate security, privacy, governance, and emerging trends in blockchain ecosystems.							
Course Outcomes:							
CO1: Explain blockchain fundamentals, distributed ledger concepts, and cryptographic techniques. (K2)							
CO2: Analyze consensus algorithms, blockchain architectures, and cryptocurrency ecosystems. (K4)							
CO3: Design and implement smart contracts and decentralized applications using blockchain platforms. (K6)							
CO4: Evaluate blockchain security, privacy, scalability, and governance challenges. (K5)							
CO5: Apply blockchain technology to real-world domains such as finance, healthcare, supply chain management, and e-governance. (K3)							
Unit-I	Fundamentals of Blockchain Technology						15 Hrs.
Introduction to Blockchain – Evolution of Distributed Systems – Blockchain Architecture – Distributed Ledger Technology (DLT) – Blockchain Components – Blocks, Transactions, and Chains – Types of Blockchain (Public, Private, Consortium, Hybrid) – Benefits, Challenges, and Applications of Blockchain Technology.							
Unit-II	Cryptography, Consensus Mechanisms and Smart Contracts						15 Hrs.
Cryptographic Foundations – Hash Functions – Digital Signatures – Public Key Cryptography – Merkle Trees – Consensus Mechanisms (PoW, PoS, DPoS, BFT) – Mining and Validation – Ethereum Architecture – Ethereum Virtual Machine (EVM) – Smart Contracts – Solidity Basics – Decentralized Applications (DApps).							

Unit-III	Blockchain Security and Emerging Applications	15 Hrs.
Blockchain Security Fundamentals – Security Threats and Attacks (Double Spending, 51% Attack, Sybil Attack) – Privacy-Preserving Techniques – Scalability Challenges – Layer-2 Solutions – Sidechains – Blockchain Governance – Cryptocurrencies – Central Bank Digital Currency (CBDC) – Supply Chain Management – Healthcare – Digital Identity – FinTech – NFTs – DeFi – Future Trends.		
Unit-IV	Blockchain Development Laboratory	8 Hrs.
<ol style="list-style-type: none"> 1. Install and configure a blockchain development environment using Ethereum, Ganache, Remix IDE, and MetaMask. 2. Demonstrate cryptographic hashing using SHA-256 for blockchain applications. 3. Generate public and private key pairs and implement digital signatures. 4. Create and validate blockchain transactions in a private blockchain network. 5. Develop and deploy a simple Solidity smart contract using Remix IDE. 6. Implement token creation using the ERC-20 standard. 		
Unit-V	Advanced Blockchain Applications Laboratory	7 Hrs.
<ol style="list-style-type: none"> 1 Develop a decentralized application (DApp) integrated with a smart contract. 2 Implement blockchain-based digital identity verification. 3 Develop a blockchain-enabled supply chain tracking application. 4 Demonstrate secure document verification using blockchain technology. 5 Analyze blockchain transactions using Ethereum blockchain explorers. 		

Text Book(s):

1. Daniel Drescher, *Blockchain Basics: A Non-Technical Introduction in 25 Steps*, 3rd Edition, Apress, 2024.
2. Imran Bashir, *Mastering Blockchain*, 4th Edition, Packt Publishing, 2023.
3. Andreas M. Antonopoulos and Gavin Wood, *Mastering Ethereum: Building Smart Contracts and DApps*, O'Reilly Media, 2022.
4. Arshdeep Bahga and Vijay Madisetti, *Blockchain Applications: A Hands-On Approach*, Universities Press, 2021.
5. Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly Media, 2020.

Reference Book(s):

1. Joseph Bonneau et al., *SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrencies*, IEEE Publications.
2. Narayan Prusty, *Building Blockchain Projects*, Packt Publishing.
3. Bettina Warburg and Bill Wagner, *Basics of Blockchain*, O'Reilly Media.
4. Debajani Mohanty, *Blockchain from Concept to Execution*, BPB Publications.
5. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies*, Princeton University Press.

e Resources:

1. <https://ethereum.org/en/developers/docs/>
2. <https://www.blockchain-council.org>
3. <https://www.hyperledger.org>
4. <https://nptel.ac.in>

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course										Hours		Credit
II	PCS26008		Blockchain Technology										5		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2	1	2	2	1	1	1	1	1	3	3	2	1.77	
CO2	3	3	2	2	3	1	1	1	1	1	3	3	3	2.08	
CO3	3	3	3	3	3	2	1	1	1	1	3	3	3	2.31	
CO4	3	3	2	3	3	3	2	2	1	2	3	3	3	2.54	
CO5	3	3	3	3	3	2	3	2	2	2	3	3	3	2.69	
	3.0	2.8	2.20	2.60	2.8	1.8	1.6	1.40	1.20	1.40	3.00	3.00	2.80	2.28	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26009	Internet of Things	DEC	3	0	2	4
Pre-Requisite: Basic knowledge of computer networks, embedded systems, and programming concepts.							
Co- Requisite: Computer Networks and Cloud Computing for IoT communication and data management.							
Progressive Course: Advanced IoT Systems, Industrial IoT (IIoT), and AI-enabled IoT Applications.							
Course Objectives:							
1. To explain the fundamental concepts, architecture, and components of the Internet of Things (IoT).							
2. To demonstrate IoT communication protocols, networking technologies, and sensor systems.							
3. To analyze IoT data management, cloud integration, and data analytics techniques.							
4. To develop IoT-based applications using embedded devices and smart systems.							
5. To evaluate security, privacy, and emerging trends in IoT ecosystems.							
Course Outcomes:							
CO1: Explain the concepts, architecture, and enabling technologies of IoT systems. (K2)							
CO2: Analyze IoT communication protocols, sensor networks, and device connectivity mechanisms. (K4)							
CO3: Design and develop IoT solutions using embedded platforms, cloud services, and data analytics tools. (K6)							
CO4: Evaluate IoT security, privacy, and interoperability challenges in real-world deployments. (K5)							
CO5: Apply IoT technologies to smart applications in healthcare, agriculture, industry, transportation, and smart cities. (K3)							
Unit-I	Fundamentals of Internet of Things						15 Hrs.
Introduction to IoT – Evolution and Characteristics of IoT – IoT Architecture – Physical and Logical Design of IoT – IoT Enabling Technologies – Sensors and Actuators – IoT Devices and Components – IoT Ecosystem – Applications and Challenges of IoT.							

Unit-II	IoT Communication and Networking	15 Hrs.
IoT Communication Models – Wireless Sensor Networks – IPv6 for IoT – RFID and NFC Technologies – Bluetooth Low Energy (BLE) – ZigBee – Wi-Fi – LoRaWAN – MQTT – CoAP – Device Discovery and Connectivity – Edge Computing – Fog Computing.		
Unit-III	IoT Platforms, Security and Smart Applications	15 Hrs.
Embedded Systems for IoT – Arduino and Raspberry Pi – IoT Middleware – Cloud Platforms for IoT – Data Collection and Storage – Stream Processing – IoT Data Analytics – Security Requirements – Authentication and Authorization – Data Encryption – Privacy Preservation – Smart Healthcare – Smart Agriculture – Smart Transportation – Smart Cities – Industrial IoT (IIoT) – AI-enabled IoT (AIoT) – Digital Twins – Emerging Trends.		
Unit-IV	Internet of Things Laboratory	8 Hrs.
<ol style="list-style-type: none"> 1. Configure and interface sensors and actuators using Arduino. 2. Develop an LED and sensor control application using Arduino programming. 3. Interface temperature, humidity, and motion sensors with Arduino/Raspberry Pi. 4. Implement serial communication between IoT devices. 5. Configure Wi-Fi/Bluetooth communication for IoT devices. 6. Publish and subscribe sensor data using the MQTT protocol. 		
Unit-V	Advanced IoT Applications Laboratory	7 Hrs.
<ol style="list-style-type: none"> 1. Develop a smart home automation application using IoT devices. 2. Implement an IoT-based environmental monitoring system. 3. Design a smart agriculture monitoring system using sensors. 4. Develop an IoT-based health monitoring application integrated with cloud services. 5. Implement data visualization and analytics for IoT sensor data using Python/cloud platforms. 		

Text Book(s):

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, 2019.
2. Raj Kamal, *Internet of Things: Architecture and Design Principles*, McGraw Hill Education, 2020.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things*, Cisco Press, 2017.
4. Samuel Greengard, *The Internet of Things*, MIT Press, 2021.
5. Vijay Madisetti and Arshdeep Bahga, *Internet of Things: Principles and Paradigms*, River Publishers, 2020.

Reference Book(s):

1. Rajkumar Buyya and Amir Vahid Dastjerdi, *Internet of Things: Principles and Paradigms*, Morgan Kaufmann, 2021.
2. Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley, 2018.
3. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms and Use Cases*, CRC Press, 2019.
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, *From Machine-to-Machine to the Internet of Things*, Academic Press, 2019.
5. Olivier Hersent, David Boswarthick and Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, Wiley, 2020.

e Resources:

1. <https://nptel.ac.in>
2. <https://www.netacad.com>
3. <https://www.arduino.cc>
4. <https://www.raspberrypi.org/documentation>

Relationship Matrix for COs, POs and PSOs

Semester	Course code		Title of the course										Hours		Credit
II	PCS26009		Internet of Things										5		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2		
CO1	3	2	2	1	2	1	1	1	1	1	3	3	2	1.85	
CO2	3	3	2	2	3	1	1	1	1	1	3	3	3	2.08	
CO3	3	3	3	3	3	2	1	1	1	1	3	3	3	2.31	
CO4	3	3	2	3	3	3	2	2	1	2	3	3	3	2.54	
CO5	3	3	3	3	3	2	3	2	2	2	3	3	3	2.69	
	3.0	2.8	2.40	2.40	2.8	1.8	1.6	1.40	1.20	1.40	3.00	3.00	2.80	2.29	

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26010	Cyber Security and Digital Forensics	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Computer Networks, Operating Systems, and Information Security.							
Co- Requisite: Computer Networks and Database Management Systems.							
Progressive Course: Ethical Hacking, Network Security, Cloud Security, Cyber Threat Intelligence, and Incident Response.							
Course Objectives:							
1	Understand the fundamental concepts, principles, and challenges of cyber security and digital forensics.						
2	Acquire knowledge of cyber threats, vulnerabilities, attack techniques, and security mechanisms.						
3	Apply digital forensic methods and tools to collect, preserve, analyze, and report digital evidence.						
4	Develop skills to implement security controls, incident response strategies, and forensic investigation procedures.						
5	Evaluate cyber security frameworks, legal regulations, and emerging technologies for securing digital environments.						
Course Outcomes:							
CO1: Explain the concepts, principles, threats, and security mechanisms of cyber security and digital forensics. (K2)							
CO2: Apply security techniques and forensic tools to identify, preserve, and analyze digital evidence. (K3)							
CO3: Analyze cyber attacks, system vulnerabilities, and forensic investigation processes. (K4)							
CO4: Evaluate cyber security frameworks, legal standards, risk management strategies, and incident response procedures. (K5)							
CO5: Design secure systems and digital forensic investigation strategies for real-world cyber security scenarios. (K6)							
Unit-I	Fundamentals of Cyber Security						15 Hrs.
Introduction to Cyber Security – CIA Triad – Information Security Principles – Cyber Threats and Attack Vectors – Malware – Phishing – Ransomware – Social Engineering – Cyber Kill Chain – Security Policies – Risk Assessment – Security Controls.							

Unit-II	Network and System Security	15 Hrs.
Network Security Fundamentals – Firewalls – Intrusion Detection and Prevention Systems (IDS/IPS) – Virtual Private Networks (VPN) – Authentication and Authorization – Cryptography Basics – Public Key Infrastructure (PKI) – Secure Communication Protocols – Endpoint Security.		
Unit-III	Digital Forensics	15 Hrs.
Introduction to Digital Forensics – Digital Evidence – Forensic Investigation Process – Evidence Collection and Preservation – Chain of Custody – Disk Forensics – Memory Forensics – File System Analysis – Email and Mobile Device Forensics – Forensic Tools (Autopsy, FTK, EnCase).		
Unit-IV	Incident Response and Cyber Crime Investigation	15 Hrs.
Cyber Incident Response – Incident Handling Life Cycle – Log Analysis – Network Traffic Analysis – Cyber Crime Investigation – Malware Analysis – Threat Intelligence – Vulnerability Assessment – Penetration Testing Concepts – Cyber Security Case Studies.		
Unit-V	Governance, Legal Issues and Emerging Trends	15 Hrs.
Cyber Security Governance – ISO/IEC 27001 – NIST Cyber Security Framework – Data Privacy – Digital Evidence Laws – IT Act 2000 (India) – GDPR Overview – Cloud Security – IoT Security – Artificial Intelligence in Cyber Security – Future Trends.		

Text Book(s):

1. William Stallings, Network Security Essentials: Applications and Standards, 7th Edition, Pearson.
2. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India.
3. Jason Andress, The Basics of Information Security, 3rd Edition, Elsevier.
4. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning.
5. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, Cengage Learning.

Reference Book(s):

1. EC-Council, Computer Forensics: Investigating Network Intrusions and Cyber Crime, Cengage Learning.
2. Eoghan Casey, Digital Evidence and Computer Crime, Academic Press.
3. Bruce Schneier, Applied Cryptography, Wiley.
4. Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, Pearson.
5. Matt Bishop, Computer Security: Art and Science, Addison-Wesley.

e Resources:

1. NIST Cybersecurity Framework – <https://www.nist.gov/cyberframework>
2. OWASP Foundation – <https://owasp.org>
3. Cyber Swachhta Kendra (India) – <https://www.cyberswachhtakendra.gov.in>
4. SANS Institute – <https://www.sans.org>
5. CERT-In (Indian Computer Emergency Response Team) – <https://www.cert-in.org.in>

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
II	PCS26010			Cyber Security and Digital Forensics								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11			PSO1
CO1	3	2	2	–	3	2	–	–	–	–	–	3	2	2.43
CO2	3	3	3	2	3	2	–	–	2	–	–	3	3	2.67
CO3	3	3	3	3	3	2	–	–	2	–	–	3	3	2.78
CO4	2	3	2	3	3	3	2	–	2	2	–	3	3	2.55
CO5	3	3	3	3	3	3	2	–	3	2	2	3	3	2.77
	2.8	2.8	2.6	2.75	3.0	2.4	2.0	–	2.25	2.0	2.0	3.0	2.8	2.64

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26011	Computer Vision and Pattern Recognition	DEC	4	0	0	4
Pre-Requisite: Basic knowledge of Digital Image Processing, Python Programming, Linear Algebra, and Machine Learning.							
Co- Requisite: Artificial Intelligence and Data Analytics.							
Progressive Course: Deep Learning, Intelligent Vision Systems, Medical Image Analysis, Robotics, and Autonomous Systems.							
Course Objectives:							
1	Understand the fundamental concepts, architectures, and applications of computer vision and pattern recognition.						
2	Acquire knowledge of image processing, feature extraction, segmentation, and visual representation techniques.						
3	Apply machine learning and deep learning algorithms for image analysis and object recognition.						
4	Develop intelligent computer vision models for solving real-world visual computing problems.						
5	Evaluate the performance of computer vision systems using appropriate metrics and emerging AI frameworks.						
Course Outcomes:							
CO1: Explain the concepts, image representation techniques, and applications of computer vision and pattern recognition. (K2)							
CO2: Apply image preprocessing, feature extraction, segmentation, and classification techniques to solve vision-related problems. (K3)							
CO3: Analyze visual data using pattern recognition and machine learning algorithms for image understanding. (K4)							
CO4: Evaluate computer vision models using performance measures and deep learning frameworks for image analysis. (K5)							
CO5: Design intelligent computer vision applications for object detection, image recognition, and real-world vision systems. (K6)							
Unit-I	Fundamentals of Computer Vision						12 Hrs.
Introduction to Computer Vision – Human Vision versus Computer Vision – Digital Image Formation – Image Representation – Image Acquisition – Color Models – Camera Models – Geometric Transformations – Applications of Computer Vision – Challenges in Computer Vision.							

Unit-II	Image Processing and Feature Extraction	12 Hrs.
Image Enhancement – Image Filtering – Histogram Processing – Edge Detection – Corner Detection – Image Segmentation – Thresholding – Morphological Operations – Feature Detection – Feature Descriptors (SIFT, SURF, ORB) – Image Registration.		
Unit-III	Pattern Recognition Techniques	12 Hrs.
Introduction to Pattern Recognition – Pattern Representation – Feature Selection – Feature Extraction – Similarity Measures – Distance Metrics – Bayesian Classification – K-Nearest Neighbor (KNN) – Support Vector Machine (SVM) – Decision Trees – Clustering Techniques – Performance Evaluation.		
Unit-IV	Deep Learning for Computer Vision	12 Hrs.
Artificial Neural Networks – Convolutional Neural Networks (CNN) – Transfer Learning – Image Classification – Object Detection – YOLO – Faster R-CNN – Semantic Segmentation – Instance Segmentation – OpenCV – TensorFlow – PyTorch.		
Unit-V	Advanced Applications of Computer Vision	12 Hrs.
Face Detection and Recognition – Optical Character Recognition (OCR) – Medical Image Analysis – Autonomous Vehicles – Intelligent Surveillance – Industrial Inspection – Augmented Reality – Gesture Recognition – Explainable AI in Vision Systems – Ethical Issues – Future Trends.		

Text Book(s):

1. Richard Szeliski, **Computer Vision: Algorithms and Applications**, 2nd Edition, Springer, 2022.
2. David A. Forsyth and Jean Ponce, **Computer Vision: A Modern Approach**, 2nd Edition, Pearson.
3. Rafael C. Gonzalez and Richard E. Woods, **Digital Image Processing**, 4th Edition, Pearson, 2018.
4. Christopher M. Bishop, **Pattern Recognition and Machine Learning**, Springer.
5. Simon J. D. Prince, **Computer Vision: Models, Learning, and Inference**, Cambridge University Press.

Reference Book(s):

1. Adrian Kaehler and Gary Bradski, **Learning OpenCV 4: Computer Vision with Python**, O'Reilly Media.
2. Aurélien Géron, **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow**, 3rd Edition, O'Reilly Media.
3. Mark Nixon and Alberto Aguado, **Feature Extraction and Image Processing for Computer Vision**, Academic Press.
4. Ethem Alpaydin, **Introduction to Machine Learning**, MIT Press.
5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, **Deep Learning**, MIT Press.

e Resources:

1. OpenCV Documentation – <https://opencv.org>
2. TensorFlow Tutorials – <https://www.tensorflow.org/tutorials>
3. PyTorch Tutorials – <https://pytorch.org/tutorials>
4. Papers with Code – Computer Vision – <https://paperswithcode.com>
5. Google AI Research – <https://ai.google/research>

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
II	PCS26011			Computer Vision and Pattern Recognition								4		4
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50
CO2	3	3	3	2	3	–	–	–	2	–	–	3	3	2.75
CO3	3	3	3	3	3	–	–	–	2	–	–	3	3	2.88
CO4	2	3	2	3	3	2	–	–	2	2	–	3	3	2.50
CO5	3	3	3	3	3	2	2	–	3	2	–	3	3	2.69
	2.8	2.8	2.6	2.75	3.0	2.0	2.0	–	2.25	2.0	–	3.0	2.8	2.66

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26012	Edge Computing and Intelligent Systems	DEC	4	0	0	4

Pre-Requisite: Basic knowledge of Computer Networks, Cloud Computing, Internet of Things (IoT), and Python Programming.

Co- Requisite: Distributed Computing and Artificial Intelligence.

Progressive Course: Fog Computing, Industrial IoT, Smart Systems, Autonomous Systems, and AI-enabled Edge Computing.

Course Objectives:

- 1 Understand the principles, architecture, and applications of edge computing and intelligent systems.
- 2 Acquire knowledge of edge infrastructure, IoT ecosystems, and distributed computing models.
- 3 Apply edge computing technologies for real-time data processing and intelligent decision-making.
- 4 Develop intelligent edge-based solutions using AI, machine learning, and IoT platforms.
- 5 Evaluate the performance, security, and scalability of edge computing systems for modern applications.

Course Outcomes:

CO1: Explain the concepts, architecture, and applications of edge computing and intelligent systems. **(K2)**

CO2: Apply edge computing technologies, IoT frameworks, and distributed architectures to solve real-time computing problems. **(K3)**

CO3: Analyze edge-based data processing, resource management, and intelligent decision-making techniques. **(K4)**

CO4: Evaluate the performance, security, privacy, and scalability of edge computing environments using appropriate metrics. **(K5)**

CO5: Design AI-enabled edge computing solutions for smart applications using modern frameworks and intelligent devices. **(K6)**

Unit-I	Fundamentals of Edge Computing	15 Hrs.
Introduction to Edge Computing – Evolution from Cloud to Edge – Characteristics and Benefits – Edge Computing Architecture – Edge Devices – Edge Gateways – Fog Computing – Cloud–Edge Continuum – Applications of Edge Computing.		
Unit-II	IoT and Distributed Edge Systems	15 Hrs.

Internet of Things (IoT) Architecture – Sensors and Actuators – IoT Communication Protocols (MQTT, CoAP) – Edge Nodes – Edge Analytics – Distributed Computing Models – Resource Allocation – Containerization at the Edge – Kubernetes and Docker Basics.

Unit-III	Intelligent Edge Computing	15 Hrs.
Artificial Intelligence at the Edge – Machine Learning for Edge Devices – TinyML – Edge Data Processing – Stream Analytics – Real-Time Decision Making – Edge Intelligence – Model Optimization – Federated Learning – Edge AI Frameworks.		
Unit-IV	Security and Resource Management	15 Hrs.
Security Challenges in Edge Computing – Authentication and Authorization – Data Privacy – Secure Edge Communication – Blockchain for Edge Computing – Resource Scheduling – Load Balancing – Energy-Efficient Computing – Performance Evaluation.		
Unit-V	Applications and Emerging Trends	15 Hrs.
Smart Cities – Smart Healthcare – Intelligent Transportation Systems – Industrial IoT – Autonomous Vehicles – Smart Agriculture – Digital Twins – 5G and Edge Computing – Explainable AI (XAI) – Future Trends in Intelligent Edge Systems.		

Text Book(s):

1. Weisong Shi, Schahram Dustdar, Edge Computing: Vision and Challenges, IEEE Computer Society Press.
2. Perry Lea, Internet of Things for Architects, Packt Publishing.
3. Rajkumar Buyya and Satish Narayana Srirama (Eds.), Fog and Edge Computing: Principles and Paradigms, Wiley.
4. Kai Hwang, Geoffrey Fox, and Jack Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann.
5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases, Cisco Press.

Reference Book(s):

1. Michael J. Kavis, Architecting the Cloud, Wiley.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.
3. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems, Pearson. William Stallings, Wireless Communications and Networks, Pearson.
4. David C. Linthicum, Cloud Computing and SOA Convergence in Your Enterprise, Addison-Wesley.

e Resources:

1. Edge Computing Consortium – <https://en.eccconsortium.org>
2. Linux Foundation – LF Edge – <https://lfedge.org>
3. Microsoft Azure IoT Documentation – <https://learn.microsoft.com/azure/iot>
4. AWS IoT Core Documentation – <https://docs.aws.amazon.com/iot>
5. Google Cloud IoT and Edge AI Resources – <https://cloud.google.com>

Relationship Matrix for COs, POs and PSOs

Semester	Course code	Title of the course										Hours		Credit
II	PCS26012	Edge Computing and Intelligent Systems										4		4
Course Outcomes (COs)	Programme Outcomes(POs)										Programme Specific Outcomes (PSOs)		Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	–	3	–	–	–	–	–	–	3	2	2.50
CO2	3	3	3	2	3	–	–	–	2	–	–	3	3	2.75
CO3	3	3	3	3	3	–	–	–	2	–	–	3	3	2.88
CO4	2	3	2	3	3	3	2	–	2	2	–	3	3	2.55
CO5	3	3	3	3	3	3	2	–	3	2	–	3	3	2.77
	2.8	2.8	2.6	2.75	3.0	3.0	2.0	–	2.25	2.0	–	3.0	2.8	2.69

MDC

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
I	PCS26901	Artificial Intelligence for Interdisciplinary Applications	MDC	3	0	0	3
Pre-Requisite: Basic knowledge of computer fundamentals and digital technologies.							
Co- Requisite: Fundamentals of Information Technology.							
Progressive Course: Machine Learning and Artificial Intelligence.							
Course Objectives:							
1. To explain the concepts, foundations, significance, and evolution of Artificial Intelligence.							
2. To describe intelligent systems and AI technologies used in everyday life and professional environments.							
3. To explore Generative AI and emerging AI technologies for interdisciplinary applications.							
4. To evaluate the impact of Artificial Intelligence across diverse sectors and disciplines.							
5. To examine the ethical, legal, and societal implications associated with Artificial Intelligence.							
Course Outcomes:							
CO1: Explain the concepts, evolution, and significance of Artificial Intelligence. (K2)							
CO2: Describe various AI technologies and intelligent systems used in real-world applications. (K2)							
CO3: Analyze the role of Generative AI and intelligent technologies in solving interdisciplinary problems. (K4)							
CO4: Evaluate AI applications in healthcare, education, agriculture, business, governance, and environmental studies. (K5)							
CO5: Assess the ethical, legal, and societal challenges associated with AI adoption. (K5)							
Unit-I	Foundations of Artificial Intelligence					12 Hrs.	
Introduction to Artificial Intelligence – Evolution and History of AI – Human Intelligence and Machine Intelligence – Types of Artificial Intelligence – Intelligent Agents – AI in Everyday Life – Human-Centered AI – Opportunities and Challenges of AI.							
Unit-II	AI Technologies and Intelligent Systems					12 Hrs.	
Machine Learning Concepts – Natural Language Processing – Computer Vision – Speech Recognition – Expert Systems – Robotics – Recommendation Systems – Intelligent Decision Support Systems.							

Unit-III	Generative AI and Emerging AI Technologies	12 Hrs.
Introduction to Generative AI – Large Language Models – Prompt Engineering Fundamentals – AI Chatbots and Virtual Assistants – AI Content Generation – AI-Assisted Learning and Research – Emerging AI Platforms and Tools.		
Unit-IV	AI Applications Across Disciplines	12 Hrs.
AI in Healthcare – Medical Diagnosis and Disease Prediction – AI in Education and Personalized Learning – AI in Agriculture and Smart Farming – AI in Business and Finance – AI in Environmental Monitoring – AI in Social Sciences and Public Administration.		
Unit-V	Responsible and Ethical Artificial Intelligence	12 Hrs.
AI Ethics – Fairness and Bias in AI – Explainable AI – Privacy and Data Protection – Intellectual Property Issues in AI – Responsible AI Practices – AI Governance and Regulations – Future of Artificial Intelligence.		

Text Book(s):

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux.
3. Neil Wilkins, Artificial Intelligence Foundations, Apress.
4. Mohan Vamsi Enaganti, Generative AI for Everyone, Notion Press.
5. Jeff Heaton, Artificial Intelligence for Humans, Heaton Research.

Reference Book(s):

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, O'Reilly Media.
3. Markus D. Dubber, Frank Pasquale and Sunit Das (Eds.), The Oxford Handbook of Ethics of AI, Oxford University Press.
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann.
5. Margaret A. Boden, Artificial Intelligence: Its Nature and Future, Oxford University Press.

e Resources:

1. IBM Artificial Intelligence Learning Hub – IBM Corporation. Available at: IBM AI Learning Hub
2. Google AI Education – Google LLC. Available at: Google AI Education
3. DeepLearning.AI Learning Platform – DeepLearning.AI. Available at: DeepLearning.AI
4. OpenAI Research and Learning Resources – OpenAI. Available at: OpenAI Research

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26901			Artificial Intelligence for Interdisciplinary Applications								3		3
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)		Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	
CO1	3	2	2	2	3	–	–	2	–	–	2	3	3	2.31
CO2	3	3	2	2	3	–	–	2	–	–	2	3	3	2.38
CO3	3	3	3	3	3	2	–	–	2	–	3	3	3	2.62
CO4	3	3	2	3	3	2	–	3	2	2	3	3	3	2.54
CO5	3	3	3	2	3	3	–	3	2	2	3	3	3	2.62
	3.0	2.8	2.40	2.40	3.0	1.4	0.0	2.00	1.20	0.80	2.60	3.00	3.00	2.49

Sem	Course Code	Title of the Course	Course Category	L	T	P	Credits
II	PCS26902	Digital Transformation and Emerging Technologies	MDC	3	0	0	3

Pre-Requisite: Basic knowledge of computer fundamentals and digital technologies.

Co- Requisite: Information Technology Fundamentals.

Progressive Course: Industry 4.0 and Emerging Technologies.

Course Objectives:

1. To explain the concepts and significance of digital transformation in organizations and society.
2. To explore technologies driving digital innovation and smart systems.
3. To examine cloud computing, IoT, and data-driven innovation frameworks.
4. To explain blockchain technologies and digital trust mechanisms.
5. To evaluate emerging technologies and their impact on future business and societal transformation.

Course Outcomes:

CO1: Explain the concepts and drivers of digital transformation. (K2)

CO2: Describe smart technologies and connected digital ecosystems. (K2)

CO3: Analyze cloud-based systems and data-driven innovation strategies. (K4)

CO4: Evaluate blockchain technologies and digital trust frameworks. (K5)

CO5: Assess emerging technologies and their impact on future innovation and societal development. (K5)

Unit-I	Digital Transformation Fundamentals	12 Hrs.
Digital Transformation Concepts – Evolution of the Digital Economy – Industry 4.0 – Society 5.0 – Digital Innovation – Digital Business Models – Technology Adoption Frameworks – Digital Leadership and Change Management.		
Unit-II	Smart Technologies and Connected Systems	12 Hrs.
Internet of Things (IoT) – Smart Devices – Sensors and Actuators – Smart Cities – Smart Healthcare – Smart Agriculture – Smart Transportation – Industrial IoT – Connected Digital Ecosystems.		

Unit-III	Cloud Computing and Data-Driven Innovation	12 Hrs.
Cloud Computing Fundamentals – Cloud Service Models – Cloud Deployment Models – Virtualization Concepts – Digital Platforms – Big Data Concepts – Data Analytics Fundamentals – Business Intelligence – Data-Driven Decision Making.		
Unit-IV	Blockchain and Digital Trust	12 Hrs.
Blockchain Fundamentals – Distributed Ledger Technology – Smart Contracts – Digital Identity Systems – Cryptocurrency Ecosystem – Applications of Blockchain – Digital Trust Frameworks – Governance and Transparency in Digital Systems.		
Unit-V	Emerging Technologies and Future Innovation	12 Hrs.
Augmented Reality (AR) – Virtual Reality (VR) – Digital Twins – Edge Computing – Quantum Computing Fundamentals – Green Computing – Sustainable Technologies – Digital Entrepreneurship – Future of Work and Innovation Ecosystems.		

Text Book(s):

1. David L. Rogers, The Digital Transformation Playbook, Columbia Business School Publishing.
2. Lindsay Herbert, Digital Transformation, Bloomsbury Publishing.
3. Thomas Erl, Cloud Computing: Concepts, Technology and Architecture, Pearson.
4. Daniel Drescher, Blockchain Basics, Apress.
5. Bernard Marr, Tech Trends in Practice, Wiley.

Reference Book(s):

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress.
2. Rajkumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Elsevier.
3. Foster Provost and Tom Fawcett, Data Science for Business, O'Reilly Media.
4. Don Tapscott and Alex Tapscott, Blockchain Revolution, Penguin Random House.
5. Brian Evergreen, Autonomous Transformation, Wiley.

e Resources:

1. NPTEL Courses on Digital Transformation and Emerging Technologies.
2. SWAYAM Online Courses.
3. Microsoft Learn – Cloud and Digital Technologies.
4. IBM Digital Transformation Learning Resources.

Relationship Matrix for COs, POs and PSOs

Semester	Course code			Title of the course								Hours		Credit
I	PCS26902			Digital Transformation and Emerging Technologies								3		3
Course Outcomes (COs)	Programme Outcomes(POs)											Programme Specific Outcomes (PSOs)	Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11			PSO1
CO1	3	2	1	2	1	2	2	2	1	1	2	3	2	1.85
CO2	3	3	2	2	3	1	1	1	1	1	3	3	3	2.08
CO3	3	3	3	2	3	1	1	1	1	1	3	3	3	2.15
CO4	2	3	2	3	2	3	2	2	1	2	3	2	3	2.31
CO5	2	2	2	3	2	3	3	3	2	3	3	2	2	2.46
	2.6	2.6	2.00	2.40	2.2	2.0	1.8	1.80	1.20	1.60	2.80	2.60	2.60	2.17