Shri. Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur
(An Autonomous Institute)
(Approved by AICTE, New Delhi, Recognized by Government of Maharashtra &
Affiliated to BATU University, Lonere)
NBA Accredited Programs, Accredited By NAAC 'A' Grade,ISO 9001:2015 Certified

Syllabus Structure of M.Tech.

(Artificial Intelligence & Data Science)

Department of

Artificial Intelligence & Data Science Engineering

Semester:I & II

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING
Dept. of Artificial Intelligence & Data Science

Head of Department,
Artificial Intelligence & Data Science
SHARAD INSTITUTE OF TECHNOLOGY
COLLEGE OF ENGINEERING,
Yadrav (Ichalkaranji) Dist. Kolhapur.

Shri. Shamrao Patil (Yadravkar) Educational & Charitable Trust's

Sharad Institute of Technology College of Engineering

Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

(An Autonomous Institute)

(Approved by AICTE, New Delhi, Recognized by Government of Maharashtra & Affiliated to BATU University, Lonere)

NBA Accredited Programs, Accredited By NAAC 'A' Grade,ISO 9001:2015 Certified

Department: Department of AIDS Engineering **Rev:** Course Structure/01/NEP/2024-25

Class: F.Y. M.Tech **Semester: I**

Course Code	Type of Course	Course	Teaching Scheme					Evaluation Scheme				
			L	T	P	Credits	Total Hrs	CA1	CA2	MSE	ESE	Total
24MAD1101	ELC	Research Methodology & IPR	3	1	0	4	4	10	10	30	50	100
24MAD1102	PCC	Digital Image Processing	3	0	0	3	3	10	10	30	50	100
24MAD1103	PCC	Data Analytics & Visualization	3	0	0	3	3	10	10	30	50	100
24MAD1104	PCC	Artificial Intelligence & Machine Learning	3	0	0	3	3	10	10	30	50	100
24MAD1105	PCC	**Bridge Course** AWS Foundation/Google Cloud Computing Foundations	2	-	-	Audit	2	25	25	--	--	50
24MAD1106	PEC	Elective – I	3	0	0	3	3	10	10	30	50	100
24MAD1107	PCC	Data Analytics & Visualization Laboratory	-	-	2	1	2	15	15	--	20	50
24MAD1108	PCC	Artificial Intelligence & Machine Learning Laboratory	-	-	2	1	2	15	15	--	20	50
24MAD1109	AEC	Effective Communication Skills	0	0	2	1	2	25	25	--	--	50
			17	**1**	**6**	**19**	**24**	**130**	**130**	**150**	**290**	**700**

Elective–I: One subject to be chosen from the following subjects.

Code	Subjects
24MAD1106A	Advanced Computer Networks
24MAD1106B	Advanced Computer Architecture
24MAD1106C	Advanced Database Technologies

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24MAD1101	ELC	Research Methodology & IPR	3-1-0	4 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week Tutorial: 1 hr /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Statistics, Communication Skills

Course Outcomes: At the end of the course, students will be able to:

CO1	Develop and implement appropriate research proposals, including formulating research questions, selecting methodologies, and designing data collection tools.
CO2	Analyze qualitative and quantitative data using relevant statistical tools and interpret the results effectively to support research findings.
CO3	Demonstrate writing skills for articles, manuscripts in the field of engineering.
CO4	Explain the fundamental concepts of intellectual property rights, ethical considerations related to research and IPR, including plagiarism, authorship, and the proper use of intellectual property.
CO5	Explain the fundamental principles of patent law, including the criteria for patentability, types of patents, and the patent application process.
CO6	Describe the key concepts of copyright law, including original works, rights of authors, and the duration and limitations of copyright protection.

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Course Contents:

Unit 1: Introduction to Research Methodology Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics.	[6]
Unit 2: Results and analysis Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artefacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.	[6]
Unit 3: Technical writing Effective technical writing, how to write a manuscript/ response to reviewers' comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee.	[6]
Unit 4: Introduction and the need for intellectual property right (IPR) Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design Genetic Resources and Traditional Knowledge – Trade Secrets, IPR in India : Genesis and development, IPR in abroad - Major International Instruments concerning Intellectual, Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994.	[6]
Unit 5: Patents Elements of Patentability: Novelty , Non Obviousness (Inventive Steps) Industrial Application - Non - Patentable Subject Matter – Registration. Procedure, Rights and Duties of Patentee, Assignment and license , Restoration of lapsed Patents, Surrender and Revocation of Patents Patent Infringement, Remedies & Penalties – Patent Office and Appellate Board. Patent/Prior art search: Types and tools of patent search, Patent drafting: Elements in patent drafting.	[6]
Unit 6: Copyrights Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings, Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright copyright Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights.	[6]

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Reference/Text Book:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.
3. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
4. P. Narayanan (Eastern Law House), Intellectual Property Law.
5. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
6. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
7. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
8. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
9. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
10. Journal of Intellectual Property Rights (JIPR): NISCAIR

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24MAD1102	PCC	Digital Image Processing	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Mathematics, Data structure

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the basic principles of digital image processing, including image formation, representation, and transformation.
CO2	Apply various image enhancement techniques to improve the visual quality of images, including histogram equalization, filtering, and contrast adjustment.
CO3	Demonstrate knowledge of image restoration methods to recover degraded images, using techniques such as deblurring and noise reduction.
CO4	Apply image compression algorithms to reduce file sizes while maintaining image quality, including lossy and lossless compression methods.
CO5	Demonstrate image segmentation algorithms to partition images into meaningful regions, using methods like thresholding, clustering, and edge detection.
CO6	Explain the application of machine learning techniques in image processing tasks, such as classification and object detection.

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Course Contents:

Unit 1: Introduction Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels.	[6]
Unit 2: Image enhancement in the spatial domain Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods.	[6]
Unit 3: Image restoration A model of the image degradation/restoration process, noise models, and restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function.	[6]
Unit 4: Image Compression Image Compression: Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards.	[6]
Unit 5: Image Segmentation Detection of discontinuous, edge linking and boundary detection, thresholding, region– based segmentation.	[6]
Unit 6: Object Recognition Patterns and patterns classes, recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching.	[6]

Reference/Text Book:

1. McAndrew A., Introduction to Digital Image Processing with Matlab, Thomson Course Technology (2004)
2. Low A., Introductory Computer Vision and Image Processing, McGraw-Hill (1991), 1st ed.
3. Gonzalez C. R., Woods E. R., Digital Image Processing, Pearson Education (2008) 3rd ed.
4. Sonka M., Hlavac V. and Boyle R., Image Processing, Analysis and Machine Vision, Thomson Learning, (1993) 1st ed.

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24MAD1103	PCC	Data Analysis and Visualization	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basics of Programming, DBMS

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the core concepts and processes involved in data analytics and visualization.
CO2	Illustrate different processes such as collect, clean, and preprocess data from various sources, ensuring data integrity and readiness for analysis.
CO3	summarize exploratory data analysis to data characteristics and identify patterns, trends, and anomalies.
CO4	Apply statistical techniques to analyze data, including descriptive statistics, inferential statistics, and regression analysis.
CO5	Design effective visualizations using various tools and techniques, ensuring clarity and accuracy in representing data insights.
CO6	Analyze real-world datasets to derive actionable insights and communicate findings effectively through ethical implications.

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Course Contents:

Unit 1: Introduction to Data Analytics Overview of Data Analytics: Definition, importance, and applications. Types of Data: Structured vs. unstructured data, primary vs. secondary data. Data Life Cycle: Collection, processing, analysis, visualization, and interpretation. Introduction to python.	[6]
Unit 2: Data Collection and Preprocessing Data Sources: Primary data collection methods, web scraping, and APIs. Data Cleaning: Handling missing values, outliers, and duplicates. Data Transformation: Normalization, aggregation, and feature engineering. Exploratory Data Analysis (EDA): Techniques for summarizing and visualizing data distributions.	[6]
Unit 3: Statistical Analysis Descriptive Statistics: Measures of central tendency and variability. Inferential Statistics: Hypothesis testing, confidence intervals, and p-values. Correlation and Regression: Understanding relationships between variables. Statistical Software: Python libraries (e.g., Pandas, NumPy, Scikit-learn).	[6]
Unit 4: Data Visualization Principles Visualization Fundamentals: Importance of data visualization and design principles. Types of Visualizations: Bar charts, line graphs, scatter plots, heatmaps, and dashboards. Tools for Visualization: Introduction to tools like Matplotlib, Seaborn. Effective storytelling with data, avoiding common pitfalls in visualization.	[6]
Unit 5: Advanced Data Analytics Techniques Introduction to Predictive Analytics and algorithms. Time Series Analysis: Techniques for analyzing time-dependent data. Text Analytics: Basic natural language processing (NLP) techniques for analyzing textual data.	[6]
Unit 6: Applications and Case Studies Real-World Applications: Exploring case studies from various industries (e.g., finance, healthcare, marketing). Hands-on project to apply concepts learned to analyze a dataset and create visualizations. Ethics in Data Analytics: Understanding ethical considerations and data privacy issues.	[6]
Reference/Text Book: 1. "Python for Data Analysis" by Wes McKinney. 2. "Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce. 3. "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. 4. "Introduction to Data Science: A Python Approach to Concepts, Techniques, and Applications" by Jeffrey Stanton.	

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5. "Data Visualization: A Successful Design Process" by Andrew Abela.
6. "Data Visualization: A Practical Introduction" by Kieran Healy.

"Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic.

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24MAD1104	PCC	Artificial Intelligence & Machine Learning	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Probability and Statistics, Basics of programming

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline fundamental concepts, history, and definitions of Artificial Intelligence (AI) and Machine Learning (ML).
CO2	Implement various supervised learning algorithms and evaluate models using different performance metrics.
CO3	Demonstrate unsupervised learning concepts and apply clustering algorithms.
CO4	Implement feedforward, convolutional (CNN), and recurrent neural networks (RNNs) to solve complex problems classification or prediction.
CO5	Summarize reinforcement learning concepts including agents, environments, rewards, and policies.
CO6	Evaluate ethical concerns related to AI, including bias, fairness, transparency, and privacy in machine learning models.

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Course Contents:

Unit 1: Introduction to Artificial Intelligence and Machine Learning Definitions and history of AI, Differences between AI, Machine Learning, and Deep Learning, Applications of AI, Machine Learning, and Deep Learning, Applications of AI (Healthcare, Finance, Robotics, etc.) Reactive Machines, Limited Memory, Theory of Mind, and Self-Aware AI, what is Machine Learning? Types of ML: Supervised, Unsupervised, and Reinforcement Learning, Data, Labels, Features, Model, Algorithm, Training, Testing, Accuracy.	[6]
Unit 2: Supervised Learning Concept of labeled data, Training and testing phases, Linear Regression, Polynomial Regression, Ridge and Lasso Regression, Logistic Regression, Decision Trees, Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), Accuracy, Precision, Recall, F1-score, ROC curves, AUC.	[6]
Unit 3: Unsupervised Learning Overview of Unsupervised Learning, K-means Clustering, Hierarchical Clustering, DBSCAN (Density-Based Clustering), Principal Component Analysis (PCA), Use of clustering for detecting outliers, Apriori Algorithm.	[6]
Unit 4: Neural Networks and Deep Learning Biological neurons vs. artificial neurons, Structure of a neuron (inputs, weights, activation functions, output), Feedforward networks, Backpropagation and gradient descent, Introduction to Deep Neural Networks, Multi-Layer Perceptron's (MLP) Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM).	[6]
Unit 5: Reinforcement Learning Agents, environments, actions, and rewards, Key differences between RL and other types of learning, States, actions, rewards, transitions, Q-learning, Temporal Difference (TD) Learning, Deep Q-Networks (DQN), Game playing (e.g., AlphaGo) Robotics, self-driving cars.	[6]
Unit 6: Ethics in AI and Machine Learning Bias and fairness in AI models, Ethical implications of AI in society, Data privacy and security, GPT models, Transformers, Large Language Models (LLMs), AI in autonomous systems (self-driving cars, drones), AI in healthcare, finance, and climate science.	[6]

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Reference/Text Book:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Pattern Recognition and Machine Learning" by Christopher Bishop.
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.
5. "Understanding Machine Learning: From Theory to Algorithms" by Shai Shalev-Shwartz and Shai Ben-David.
6. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto.
7. "Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth.

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24MAD1105	PCC	Bridge Course	2-0-0	Audit

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs /week	CA I: 25 Marks CA II: 25 Marks

Pre-Requisites: Cloud Computing

Course Contents:

- The Bridge Course is designed to equip students with fundamental cloud computing skills and hands-on experience.
- Students must create and maintain their own cloud accounts for hands-on labs. Be responsible for managing costs, especially with free-tier limits.
- Ensure all cloud lab exercises are completed as instructed. Follow the steps provided in the tutorials or documentation.
- Use the recommended course materials, AWS/Google documentation, and other official resources. Unauthorized use of third-party services for labs (e.g., copying others' solutions) is not allowed.
- students are encouraged to prepare for an cloud certification exam (e.g., AWS Certified Solutions Architect - Associate) as part of the course's completion.
- Follow the guidelines and ethical practices while using cloud services. Any misuse or violation of cloud policies will lead to penalties.
- Complete all course modules, labs, quizzes, and the final project to receive a course completion certificate.
- Grading will be based on participation, assignments, labs, and quizzes. Achieving a passing score is required to successfully complete the bridge course.

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24MAD1106A	PEC	Advanced Computer Networks	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Computer Networks

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the classification of network services, routing protocols and architectures.
CO2	Illustrate IPv6 Network.
CO3	Make use of routing protocol to solve the given network situation.
CO4	Demonstrate different Transport Layer Protocols
CO5	Examine the Application layer protocols
CO6	Distinguish wired and wireless networking concept

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Course Contents:

Unit 1: Internetworking Routing Algorithms: Distance Vector Routing, Bellman-ford algorithm, Link State Routing, Path Vector Routing, Congestion Control, Quality of Service, Queue Management, High Speed Networks, Performance Modeling and Estimation.	[6]
Unit 2: IPv6 IPv4 deficiencies, Transition from IPv4 to IPv6:Dual Stack, Tunneling, Header Translation, IPv6 addressing: Representation, address space, address space allocation, Auto configuration, Renumbering, IPv6 Protocol: Packet Format, Extension Header.	[6]
Unit 3: Unicast and Multicast Routing Protocols Introduction: Inter-domain, Intra-domain Routing, Unicast, Multicast and Broadcast, Unicast Routing Protocols: Internet structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version4.Multicast Routing Protocols: Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF), Protocol Independent Multicast(PIM).	[6]
Unit 4: Transport Layer Protocols User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timer, Options., SCTP: SCTP Services, SCTP features, Packet Format, SCTP association, Flow Control, Error Control.	[6]
Unit 5: Application Layer Protocols World wide web and HTTP, File Transfer: FTP & TFTP, Electronic Mail: Architecture, Web-based mail, Email Security, SMTP, POP, IMAP and MIME, SNMP. DNS: Concept of Domain name space, DNS operation, DHCP: Static and Dynamic Allocation, DHCP Operation, Remote Login: TELNET and SSH.	[6]
Unit 6: Ad Hoc Wireless Networks MAC Protocols for AdHoc Wireless Networks, Routing Protocols for Ad Hoc Wireless Networks, Multicast routing in Ad Hoc Wireless Networks, Transport Layer and Security Protocols for AdHoc Wireless Networks, Quality of Service in Ad Hoc Wireless Networks.	[6]
Reference/Text Book: 1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill. 2. Andrew Tanenbaum "Computer Networks", Prentice Hall.	

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3. William Stallings, "Data and Computer Communication", Pearson.
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann.
6. W. A. Shay, "Understanding Communications and Networks", Cengage Learning.
7. D. Comer, "Computer Networks and Internets", Pearson.
8. Behrouz Forouzan, "TCP/IP Protocol Suite", McGraw Hill.

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24MAD1106B	PEC	Advanced Computer Architecture	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Computer organization and architecture

Course Outcomes: At the end of the course, students will be able to:

CO1	Summarize different computational models and processing techniques.
CO2	Illustrate the classifications & current trends of Computer Architecture; evaluate & compare System's performance using standard benchmarks.
CO3	Explain memory organization and memory structure of different architectures.
CO4	Identify the advanced RAID Levels, compare SAS vs SATA Disks & understand the implementation of a hierarchical Storage System.
CO5	Explain different software architectures and differences between System Area Networks, Storage Area Networks & analyze the current Networking Technologies for implementing them.
CO6	Outline the advanced microprocessor techniques & the salient features of state-of-the- art processors deployed in current High Performance Computing systems.

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Course Contents:

Unit1: Computational Models Basic computational models, interpretation to the concept of computer architectures at different levels of abstraction. Introduction to parallel Processing: basic concepts, program, process and threads in languages, concepts of parallel concurrency and parallel execution, types and levels of parallelism, classification of parallel architectures, basics parallel techniques, pipelining and replication applications. Pipelined Processors – basic concepts, design space of pipelines, case study: pipelined instruction processing in the Pentium processor and PowerPC 604, VLIW Architectures.	[6]
Unit2: System Architecture Flynn's Classification: SISD, SIMD, MISD, MIMD. Physical Models: PVP, MPP, SMP& Cluster of Workstations (COW). Memory Architectures: Shared, Distributed & Hybrid. UMA, NUMA, CC-NUMA.	[6]
Unit3: Memory organization Basic naming, allocation and accessing techniques, name mapping implementations, name translation before program execution, name translation by an executing program, memory interleaving, memory bandwidth and granularity, memory organizations for array processors, contentions in shared memory architectures, memory structure of SPARC, ALPHA AXP AND MC680*0 architectures.	[6]
Unit 4: Storage Internal/External , Disk Storage, Areal Density ,Seek Time ,Disk Power, Advanced RAID Levels, SATA vs SAS Disks ,Network Attached Storage (NAS) ,Direct Attached Storage (DAS), I/O Performance Benchmarks.	[6]
Unit 5: Software Architecture and System Interconnects Typical HPCC, Software Stack including Cluster Monitoring Tools, Public Domain Software like GANGLIA, CUDA Programming Environment. SAN : System Area Networks, Storage Area Networks including InfiniBand, Gigabit Ethernet, Scalable Coherent Interface (SCI) Standard.	[6]
Unit 6: Advanced Microprocessor Techniques CISC, RISC, EPIC, Superscalar, Superpipelined Architectures, Superscalar/ Superpipelined, In Order Execution /Out of Order Execution (OOO), ILP, TLP, Power Wall, Moore's Law Redefined, Multicore Technologies, Intel's Tick-Talk Model. Study of State-of-the- ART Processors : Intel / AMD X86-64 Bit Series: Intel Xeon Family (Xeon Haswell & Broadwell Architectures), Intel Xeon Phi	[6]

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Coprocessors (MIC Architecture) Intel/IBM Itanium/Power Series (Power 4 - Power 9).	

Reference/Text Book:

1. John L. Hennesy and David Patterson, Computer Architecture : A Quantitative Approach, 6th Edition, Elsevier
2. Kai Hwang and Zhiwei Xu, Scalable Parallel Computers, McGraw- Hill, 1998.
3. Data Manuals of respective Processors available at Website
4. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Elsevier Series, 2011, ISBN:978-0-12-374260-5.
5. Computer Organization and Design: The hardware/Software Interface (4th edition),
6. By David A.Patterson and John L. Hennessy, Morgan Kaufmann, 2008.

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24MAD1106C	PEC	Advanced Database Technologies	3-0-0	3 Credits

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs /week	CA I: 10 Marks CA II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Database management system

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the architecture and design of advanced database systems.
CO2	Apply NoSQL databases and NewSQL databases concepts.
CO3	Apply In-Memory Databases and Graph Databases.
CO4	Demonstrate Cloud-Based Database Technologies.
CO5	Apply skills in managing and analyzing big data.
CO6	Illustrate applications of IOT and edge with database.

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SHARAD INSTITUTE OF TECHNOLOGY
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Yadrav (Ichalkaranji) Dist. Kolhapur.

Course Contents:

Unit1: Introduction to Advanced Database Technologies Evolution of database systems: From RDBMS to NoSQL and beyond, Overview of modern data challenges: Big Data, real-time processing, and scalability, Introduction to advanced database technologies and their significance.	[6]
Unit2: NoSQL Databases and NewSQL Databases Introduction to NoSQL Database, Types-Key-value stores, Document databases, Column-family stores (e.g., Cassandra, HBase), Graph databases, Features of NoSQL, Advantages and disadvantages of NoSQL, Introduction to NewSQL Database, Characteristics of NewSQL databases, Advantages and disadvantages, Google Spanner, VoltDB, CockroachDB comparison between SQL, NoSQL, NewSQL.	[6]
Unit3: In-Memory Databases and Graph Databases Architecture and design of in-memory databases, SAP HANA, Redis, Memcached, Performance optimization using in-memory databases, Introduction to graph theory and data modeling, Query languages for graph databases: Cypher, Gremlin, Neo4j, Amazon Neptune, OrientDB, Applications: Social networks, recommendation systems, fraud detection.	[6]
Unit 4: Cloud-Based Database Technologies Overview of cloud database services: AWS RDS, Google Cloud Spanner, Azure Cosmos DB, Database as a Service (DBaaS) models, Scalability, availability, and disaster recovery in cloud databases, Security and compliance challenges in cloud-based database management.	[6]
Unit 5: Big Data and Distributed Data Processing Introduction to Big Data technologies and the Hadoop ecosystem, Distributed file systems (HDFS) and distributed computing (MapReduce), Real-time data processing with Apache Spark and Flink, Integration of Big Data technologies with modern database systems.	[6]
Unit 6: Emerging Trends and Future Directions Blockchain databases and decentralized data storage. Time-series databases (e.g., InfluxDB, TimescaleDB), Multi-model databases: ArangoDB, OrientDB, Database technologies for IoT and edge computing, Future trends in database technology: AI-	[6]

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driven databases, quantum databases.	

Reference/Text Book:

1. "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" by Pramod J. Sadalage and Martin Fowler.
2. "NewSQL: Database Technology for Future-Scale Applications" by Guy Harrison.
3. "Graph Databases" by Ian Robinson, Jim Webber, and Emil Eifrem.
4. "In-Memory Data Management: Technology and Applications" by Hasso Plattner and Alexander Zeier.

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24MAD1107	PCC	Data Analytics & Visualization Laboratory	0-0-2	1 Credit

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs /week	CA I: 15 Marks CA II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Basics of Programming, DBMS

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the core concepts and processes involved in data analytics and visualization.
CO2	Illustrate different processes such as collect, clean, and preprocess data from various sources, ensuring data integrity and readiness for analysis.
CO3	summarize exploratory data analysis to data characteristics and identify patterns, trends, and anomalies.
CO4	Apply statistical techniques to analyze data, including descriptive statistics, inferential statistics, and regression analysis.
CO5	Design effective visualizations using various tools and techniques, ensuring clarity and accuracy in representing data insights.
CO6	Analyze real-world datasets to derive actionable insights and communicate findings effectively through ethical implications.

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Experiment List:

Minimum 7 experiments should be performed from the following list.

1. Import a dataset from CSV, Excel, or an online source (e.g., API or web scraping), Handle missing values (imputation, deletion), Perform data normalization, standardization, and data encoding (for categorical variables), Identify and remove outliers using statistical methods.
2. Generate descriptive statistics (mean, median, mode, variance), Visualize data distributions (histograms, box plots). Plot pairwise relationships (scatterplots, heatmaps) to analyze correlations. Detect patterns and trends in time-series data.
3. Plot bar charts, line charts, and pie charts for categorical and numerical data. Use advanced visualizations like violin plots, swarm plots, and pair plots. Customize visualizations (color palettes, legends, titles, labels).
4. Create interactive charts (bar, line, pie, maps). Use filters, slicers, and parameters to make the dashboard dynamic. Implement drill-down functionalities for deeper insights. Share or publish the dashboard.
5. Preprocess text data (tokenization, stemming, lemmatization). Perform sentiment analysis using TextBlob or VADER. Visualize the results using word clouds, bar charts, and pie charts for sentiment distribution. Perform basic text classification to categorize positive and negative reviews.
6. Apply the Apriori algorithm to a dataset (e.g., supermarket transactions). Generate frequent itemsets and association rules. Visualize the results using bar charts and network graphs.
7. Plot and analyze time-series data (e.g., stock prices, sales data). Decompose the time series into trend, seasonality, and noise. Apply time series forecasting models (ARIMA, Exponential Smoothing). Visualize forecasted values and evaluate the model performance.
8. Create and populate a database with sample data. Write SQL queries to extract, aggregate, and analyze data (e.g., GROUP BY, JOIN, HAVING). Perform advanced operations like window functions for data analytics. Visualize query results using Python.
9. Load and plot geospatial data (e.g., city locations, customer distributions). Create maps and visualize data points on geographic regions. Perform spatial analysis (e.g., distance calculations, clustering based on location). Use heatmaps or choropleth maps to visualize density or distribution.

24MAD1108	PCC	Artificial Intelligence & Machine Learning Laboratory	0-0-2	1 Credit

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs /week	CA I: 15 Marks CA II: 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Probability and Statistics, Basics of programming

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline fundamental concepts, history, and definitions of Artificial Intelligence (AI) and Machine Learning (ML).
CO2	Implement various supervised learning algorithms and evaluate models using different performance metrics.
CO3	Demonstrate unsupervised learning concepts and apply clustering algorithms.
CO4	Implement feedforward, convolutional (CNN), and recurrent neural networks (RNNs) to solve complex problems classification or prediction.
CO5	Summarize reinforcement learning concepts including agents, environments, rewards, and policies.
CO6	Evaluate ethical concerns related to AI, including bias, fairness, transparency, and privacy in machine learning models.

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Experiment List:

Minimum 7 experiments should be performed from the following list.

1. Implement Depth-First Search (DFS) and Breadth-First Search (BFS) for solving problems like a maze or a puzzle. Implement A* Search Algorithm and compare it with DFS and BFS. Analyze the performance and complexity of each algorithm.
2. Use a binary classification dataset (e.g., Titanic dataset). Implement logistic regression using Scikit-learn. Visualize the decision boundary. Evaluate the model using accuracy, confusion matrix, and ROC-AUC curve.
3. Implement KNN algorithm from scratch or use Scikit-learn. Test the model on datasets like Iris or Breast Cancer. Tune hyperparameters such as k-value (number of neighbors) and distance metrics. Evaluate the model performance using confusion matrix and cross-validation.
4. Train a decision tree classifier on a dataset (e.g., Wine dataset). Visualize the decision tree. Perform pruning to avoid overfitting. Evaluate model performance using metrics like accuracy and confusion matrix.
5. Implement SVM using the Scikit-learn library. Train the SVM on datasets such as Iris or Breast Cancer. Experiment with different kernels (linear, polynomial, RBF) and tune hyperparameters. Visualize the decision boundary and evaluate the model performance.
6. Implement K-Means algorithm to cluster a dataset (e.g., Iris or Mall Customers dataset). Determine the optimal number of clusters using the elbow method. Visualize the clusters and centroids.
7. Apply PCA on a high-dimensional dataset (e.g., Wine dataset). Visualize the explained variance for each principal component. Reduce the dataset to two or three dimensions and visualize the clusters. Use the reduced dataset for further classification tasks.
8. Load and preprocess an image dataset (e.g., CIFAR-10 or MNIST). Build a simple CNN with convolutional and pooling layers. Train the CNN and evaluate its performance using accuracy and loss. Visualize the training process and model predictions on test images.
9. Implement the Q-Learning algorithm. Apply it to simple environments like the Frozen Lake or CartPole problem from OpenAI Gym. Visualize the agent's performance as it learns over time. Tune hyperparameters like learning rate and discount factor to optimize the agent's behavior.

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24MAD1109	AEC	Effective Communication Skills	0-0-2	1 Credit

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs /week	CA I: 25 Marks CA II: 25 Marks

Pre-Requisites: Basics of communication skills, Ethics

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the ability to communicate effectively in verbal and non-verbal forms.
CO2	Examine proficiency in written communication across different formats.
CO3	Demonstrate presentation and public speaking skills with confidence and clarity.
CO4	Apply interpersonal communication skills to effectively manage and resolve conflicts.
CO5	Develop the ability to communicate in group discussions, debates, and team settings.
CO6	Adapt the ability of various communication style and techniques to diverse audiences.

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Experiment List:

Minimum 7 experiments should be performed from the following list.

1. Self-Introduction Practice- Each student prepares a 1–2-minute self-introduction covering their background, interests, and goals. Practice in front of peers, focusing on tone, clarity, and confidence. Receive feedback on body language, eye contact, and speaking style.
2. Group Discussion on Current Topics- Form small groups to discuss current events or topics relevant to the field of study (e.g., AI advancements, climate change). Each group member is encouraged to express their thoughts clearly and contribute to the discussion. Evaluate participation based on coherence, confidence, listening skills, and respect for differing opinions.
3. Presentation Skills Development- Each student prepares a short presentation (3-5 minutes) on a chosen topic. Focus on structure (introduction, body, conclusion), use of visuals (PowerPoint), voice modulation, and engagement with the audience. Peers and instructors give constructive feedback on clarity, body language, and interaction with the audience.
4. Email Writing and Professional Communication- Students draft emails for different situations: job applications, customer service inquiries, internal team communication, etc. Focus on professionalism, tone, clarity, and structure (subject line, salutation, body, closing). Provide feedback on grammar, tone, conciseness, and whether the message meets its intended purpose.
5. Debate on Controversial Topics- Organize a formal debate on a controversial or thought-provoking topic (e.g., "Social Media is a Blessing or a Curse"). Students are divided into teams to present arguments for and against the topic. Focus on structured arguments, use of evidence, rebuttals, and persuasive language. Evaluate based on clarity, coherence, logical reasoning, and emotional appeal.
6. Negotiation Skills Simulation- Simulate real-world negotiation scenarios (e.g., salary negotiation, resolving a workplace conflict). Practice negotiation techniques such as establishing common ground, assertiveness, compromise, and maintaining a calm demeanor. Evaluate based on the ability to communicate needs clearly, listen actively, and reach a mutually beneficial agreement.
7. Mock Job Interview- Conduct mock interviews where students take on the role of

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interviewees for different job roles. Focus on answering common interview questions (e.g., "Tell me about yourself", "What are your strengths and weaknesses?"). Provide feedback on verbal responses, body language, professionalism, and ability to handle challenging questions. Students learn to communicate their qualifications and personality confidently.

8. Understanding Non-Verbal Communication- Analyze non-verbal cues in different videos or role-play activities. Have students practice using appropriate gestures, posture, and eye contact in various communication scenarios. Provide feedback on how non-verbal communication aligns with their verbal message.
9. Team Communication and Collaboration- Organize a group task (e.g., solving a case study, creating a presentation, or brainstorming ideas). Assign roles within the team (leader, presenter, researcher) and encourage collaboration. Assess communication within the team, leadership, listening skills, and how ideas are shared effectively.