3.2 Programme Outcomes (POs):

PO 1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences..

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions..

PO 5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations..

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3.3 Programme Specific Outcomes (PSO's)

PSO 1: Students will have adequate knowledge of computer engineering domain including the latest technology in software and hardware to become employable in Industry.

PSO 2: Students will have strong fundamentals and problem solving skills with industrial training to analyze.

PSO 3: Students will be aware of recent research trends, higher education and entrepreneurial opportunities, and will work ethically towards society.

Course Outcomes(COs) forB.Tech.(CSE)

M.Tech (CSE)
Program Outcomes (POs)

PO 1: **Advanced Technical Knowledge**: Students should have an in-depth understanding of advanced concepts, theories, and principles in computer science and engineering.

PO 2: **Problem Analysis:** Apply current techniques, skills and modern engineering tools to build robust, reliable, maintainable, scalable and efficient computing systems by considering social, environmental, economic, and security constraints...

PO 3: Research Skills: Students should be capable of conducting independent research, including literature review, experimental design, and data analysis

PO 4: **Algorithmic Thinking:** Students should possess strong algorithmic thinking skills and be able to design and analyze algorithms for solving complex computational problems

PO 5: **System Design and Analysis:** Identify, formulate and critically study the problem, design and develop efficient algorithms, conduct experiments, analyzing the results and applying the knowledge to different domains.

PO 6: Advance Technologies: Apply advance concepts of machine learning and AI concepts and be able to apply them to real-world problems..

PO 7: Project Management: Students should be capable of managing complex engineering projects, including planning, execution, and monitoring..

PO 8: Modern Tools & usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 9: Ethical and Social Responsibility: Become a complete professional with high integrity and ethics, with excellent professional conduct and with empathy towards the environmental and social needs

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PO 10: Lifelong Learning: Learn independently and engage in lifelong learning with understanding of professional, social and ethical responsibilities for the need of sustainable development.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Students should be able to develop and Research the solution of real life computing problems using contemporary technologies.

PSO 2: Students should be able to apply ethical principles and commit to professional and social responsibilities.

Course Outcomes(COs) for M.Tech (Computer Science & Engineering)

S.No.	CourseCode	CourseTitle	CourseOutcomes
FirstSemester			
1	CSE-411	Advanced Data Structures and Algorithms	CO-1: Design and implement efficient data structures for solving complex computational problems in various domains. CO-2: Analyze the time and space complexity of algorithms and use this knowledge to develop optimized algorithms for efficient data manipulation and retrieval. CO-3: Apply advanced data structures and algorithms to develop solutions for real-world problems in areas such as network optimization, image processing, and artificial intelligence. CO-4: Evaluate the performance of different data structures and algorithms in terms of time and space efficiency, and select appropriate ones based on specific requirements and constraints. CO-5: Collaborate effectively in a team to design and develop complex data structures and algorithms, and communicate the design choices, implementation details, and performance analysis in a clear and concise manner.
2	CSE-412	ComputerNetworks	CO-1: Analyze and evaluate the principles and protocols underlying computer networks, demonstrating a comprehensive understanding of their functionalities and components. CO-2: Design and implement efficient and secure network architectures, incorporating appropriate protocols and technologies to meet specific requirements and constraints. CO-3: Evaluate the performance of computer networks using appropriate metrics and tools, and propose optimization strategies to enhance network efficiency and reliability. CO-4: Identify and assess potential security threats and vulnerabilities in computer networks, and implement effective countermeasures to protect network infrastructure and data. CO-5: Apply theoretical knowledge and practical skills to troubleshoot and resolve network-related issues, demonstrating competence in diagnosing and rectifying network problems effectively.
3	CSE-413	AdvancedSoftware Engineering	CO-1: Apply advanced software engineering principles and techniques to design, develop, and maintain complex software systems. CO-2: Analyze and evaluate software requirements to ensure they are complete, consistent, and aligned with stakeholder needs, and propose effective solutions. CO-3: Employ advanced software testing and quality assurance methodologies to ensure the reliability, efficiency, and maintainability of software systems. CO-4: Utilize modern software project management practices to effectively plan, execute, and control software development projects, taking into account

			constraints and risks. CO-5: Demonstrate proficiency in identifying and resolving software engineering problems using innovative approaches and tools, and effectively communicate solutions to both technical and non-technical stakeholders.
4	CSE-414	SecurityinComputing	CO-1: Identify and analyze common vulnerabilities in computing systems and networks, and propose effective security measures to mitigate these vulnerabilities. CO-2: Evaluate and select appropriate encryption algorithms, authentication mechanisms, and access control strategies to ensure the confidentiality, integrity, and availability of sensitive information and resources. CO-3: Design and implement secure software applications, considering principles of secure coding, secure software development lifecycle, and best practices for threat modeling and risk assessment. CO-4: Investigate and assess various types of cyber threats, such as malware, phishing, and social engineering attacks, and develop strategies to detect, prevent, and respond to these threats effectively. CO-5: Apply ethical and legal frameworks to analyze and address ethical issues related to security in computing, including privacy concerns, intellectual property rights, and compliance with relevant regulations and standards.
5	CSE-511/512/513	Elective–I (Mobileadhocand sensor network)	CO-1: Analyze the fundamental concepts and principles of mobile ad hoc and sensor networks, including their architectures, communication protocols, and security mechanisms. CO-2: Design and implement efficient routing algorithms and protocols for mobile ad hoc and sensor networks, taking into account factors such as network topology, energy efficiency, and quality of service requirements. CO-3: Evaluate the performance of mobile ad hoc and sensor networks through simulation and analysis, considering metrics such as throughput, latency, packet delivery ratio, and energy consumption. CO-4: Apply knowledge of mobile ad hoc and sensor networks to develop practical solutions for real-world problems, such as optimizing network connectivity, resource allocation, and data aggregation in dynamic and resource-constrained environments. CO-5: Demonstrate an understanding of the challenges and research trends in mobile ad hoc and sensor networks, and contribute to the advancement of the field through critical thinking, problem-solving, and innovative ideas.

M.Tech (Data Science)
Program Outcomes (POs)

PO 1: **Advanced Technical Knowledge**: Students should have an in-depth understanding of advanced concepts, theories, and principles in computer science and engineering.

PO 2: **Problem & Complex Analysis:** Apply current techniques, skills and modern engineering tools to build robust, reliable, maintainable, scalable and efficient computing systems by considering social, environmental, economic, and security constraints.

PO 3: Statistical Modeling: Students should have a strong foundation in statistical concepts and be able to apply statistical models to make data-driven decisions

PO 4: **Technical & Research Skills:** Students should be capable of conducting independent research, including literature review, experimental design, data analysis and ability to write and present a substantial technical report/document and programming languages

PO 5: **Algorithmic Thinking:** Students should possess strong algorithmic thinking skills and be able to design and analyze algorithms for solving complex computational problems.

PO 6: System Design and Analysis: Identify, formulate and critically study the problem, design and develop efficient algorithms, conduct experiments, analyzing the results and applying the knowledge to different domains

PO 7: Ethical and Social Responsibility: Become a complete professional with high integrity and ethics, with excellent professional conduct and with empathy towards the environmental and social needs.

PO 8: Lifelong Learning: Learn independently and engage in lifelong learning with understanding of professional, social and ethical responsibilities for the need of sustainable development.

PO 9: Collaboration and Teamwork: Students should be able to work effectively in inter disciplinary teams, as data science often involves collaboration with experts from various fields.

PROGRAMME SPECIFIC OUTCOMES

PSO1- Understand the mathematical concepts behind the algorithms employed in data science and analyse the existing algorithms from a mathematical perspective.

PSO2 – Conduct research in the area of data science and pursue a career in research and development pertinent to data science.

PSO3 – Apply the tools and techniques of data science in the areas of NLP, Healthcare, Cyber Security, Smart Grids and Game Physics.

Course Outcomes (COs) for M.Tech (Data Science)

S.No.	CourseCode	CourseTitle	CourseOutcomes
FirstSemester			
1	M-DS-01	Introduction To Data Science	CO-1: Identify and describe the fundamental concepts and techniques used in data science, including data acquisition, cleaning, exploration, and visualization. CO-2: Apply various statistical and machine learning algorithms to analyze large datasets, and evaluate their performance based on appropriate metrics. CO-3: Design and implement data processing pipelines using programming languages and tools commonly used in data science, such as Python and R. CO-4: Utilize data mining techniques to extract valuable insights and patterns from complex datasets, and effectively communicate the findings through data visualization and storytelling. CO-5: Evaluate the ethical and legal considerations related to data science, including privacy, security, and bias, and demonstrate responsible and ethical practices in data collection, analysis, and reporting.
2	M—DS-02	Mathematics For Data Science	CO-1: Apply mathematical concepts and techniques to analyze and solve data science problems effectively. CO-2: Employ mathematical modeling and optimization techniques to address complex data science challenges. CO-3: Demonstrate proficiency in statistical analysis and inference to draw meaningful conclusions from data sets. CO-4: Utilize mathematical tools and algorithms for data visualization and exploration to gain insights from large-scale datasets. CO-5: Apply mathematical reasoning and logical thinking to design and evaluate machine learning algorithms for data analysis and prediction.
3	M---DS-03	Introduction To ML	CO-1: Analyze the fundamental concepts and principles of machine learning, including supervised and unsupervised learning techniques, to identify suitable algorithms for different types of data analysis problems. CO-2: Apply various machine learning algorithms, such as decision trees, support vector machines, and neural networks, to preprocess and analyze datasets, making informed decisions on feature selection, dimensionality reduction, and model optimization. CO-3: Evaluate the performance of machine learning models using appropriate evaluation metrics and techniques, considering factors such as accuracy, precision, recall, and F1-score, to assess the effectiveness and reliability of the models. CO-4: Design and implement machine learning pipelines, incorporating data preprocessing, feature engineering, model training, and model evaluation, to solve real-world data science problems in various domains. CO-5: Demonstrate an understanding of ethical

			considerations, privacy concerns, and legal aspects associated with machine learning, and apply responsible practices while developing and deploying machine learning models to ensure fairness, transparency, and accountability in decision-making processes.
4	M-DS-04	Data Structure & Algorithm	CO-1: Apply various data structures and algorithms to solve complex problems in the field of data science. CO-2: Design and implement efficient algorithms for manipulating, storing, and retrieving data. CO-3: Analyze the time and space complexity of algorithms to evaluate their efficiency and scalability. CO-4: Develop and evaluate algorithms for sorting, searching, and graph traversal, considering their applicability in data science. CO-5: Implement advanced data structures, such as trees, heaps, and hash tables, and utilize them effectively in solving data science problems.

S.No.	CourseCode	CourseTitle	CourseOutcomes
SecondSemester			
1	M-DS-07	Data Mining	CO-1: Apply advanced data mining techniques to extract meaningful patterns, associations, and insights from large and complex datasets. CO-2: Design and implement data preprocessing strategies to cleanse, transform, and integrate diverse data sources for effective data mining. CO-3: Evaluate and select appropriate data mining algorithms and models to solve real-world problems, considering their strengths, limitations, and applicability. CO-4: Analyze and interpret data mining results accurately, effectively communicating the findings to stakeholders in a clear and understandable manner. CO-5: Apply ethical considerations and legal frameworks while handling sensitive and confidential data in the data mining process, ensuring privacy and security.

2	M-DS-21-24	Business Analytics	CO-1: Apply statistical and quantitative techniques to analyze business data and derive meaningful insights for decision-making. CO-2: Utilize data mining and predictive modeling techniques to identify patterns and trends in large datasets, enabling effective business forecasting and planning. CO-3: Design and implement business intelligence systems and tools to collect, integrate, and visualize data, enabling informed decision-making at various organizational levels. CO-4: Evaluate the effectiveness of business analytics solutions and recommend improvements for enhancing business performance and competitiveness. CO-5: Demonstrate proficiency in using popular business analytics software and tools to solve real-world business problems, leveraging data-driven strategies for sustainable growth and innovation.
3	M-DS-08	Statistical Foundation For Data Science	CO-1: Apply foundational statistical concepts to analyze and interpret data in the field of data science. CO-2: Demonstrate proficiency in using statistical software packages to perform data analysis and generate meaningful insights. CO-3: Design and implement appropriate statistical models and techniques to solve real-world problems in data science. CO-4: Evaluate and critically analyze the validity and reliability of statistical methods used in data science research and applications. CO-5: Communicate effectively, both orally and in writing, about statistical analyses and their implications for data science projects and decision-making processes.
4	M-DS-09	Matrix Computation	CO-1: Apply matrix computations to solve real-world problems in the field of data science. CO-2: Analyze and evaluate different matrix factorization techniques for data analysis and machine learning applications. CO-3: Design and implement efficient algorithms for matrix operations and computations, considering computational complexity and numerical stability. CO-4: Assess the performance and scalability of matrix computation algorithms in large-scale data processing scenarios. CO-5: Apply advanced matrix computation techniques, such as singular value decomposition and eigenvalue decomposition, for dimensionality reduction and feature extraction in data science tasks.
5	M-DS-10	Elective -2 (Neural Network)	CO-1: Demonstrate a comprehensive understanding of the fundamental concepts and theories underlying neural networks in the context of data science. CO-2: Apply mathematical and computational techniques to design, implement, and evaluate neural network models for solving real-world problems in various domains. CO-3: Analyze and interpret the behavior of neural network models, including their strengths, limitations, and performance characteristics, to make informed decisions in data science applications. CO-4: Develop advanced skills in optimizing and fine-

			tuning neural network architectures, algorithms, and hyperparameters to enhance the performance and efficiency of the models. CO-5: Critically evaluate and compare different neural network architectures and algorithms, and effectively communicate the findings and insights to both technical and non-technical stakeholders.
6	M-DS-10	Elective -2 (Natural Language Processing)	CO-1: Analyze and apply fundamental concepts of Natural Language Processing (NLP) to extract meaningful information from unstructured text data. CO-2: Design and implement NLP models and algorithms for tasks such as text classification, sentiment analysis, named entity recognition, and information extraction. CO-3: Evaluate and compare different NLP techniques and methodologies, considering their strengths, limitations, and applicability to various domains and datasets. CO-4: Develop and deploy NLP systems and applications, integrating techniques like tokenization, parsing, language modeling, and machine translation to enhance text understanding and generation. CO-5: Critically assess ethical considerations and challenges in NLP, including bias, privacy, and fairness, and propose strategies for responsible and inclusive NLP development and deployment.

S.No.	CourseCode	CourseTitle	CourseOutcomes
ThirdSemester			
1	M-DS-13	SEMINAR	CO-1: Analyze and evaluate the latest advancements in data science methodologies and techniques showcased in seminars. CO-2: Critically assess the implications of emerging technologies and their impact on data science during seminar discussions. CO-3: Apply critical thinking skills to identify challenges and potential solutions in data science through engaging in seminar activities. CO-4: Develop effective communication and presentation skills to effectively articulate complex data science concepts during seminars. CO-5: Demonstrate an understanding of ethical considerations and professional responsibilities associated with data science in seminar settings.
2	M-DS-14	Minor Project	CO-1: Apply advanced data science techniques to analyze complex datasets and extract meaningful insights for solving real-world problems. CO-2: Design and implement a comprehensive data science project, integrating various stages such as data collection, preprocessing, modeling, and evaluation. CO-3: Employ advanced machine learning algorithms and statistical methods to develop predictive models and make accurate predictions in diverse domains. CO-4: Demonstrate proficiency in utilizing big data technologies and tools to efficiently handle and process large-scale datasets for data analysis and modeling. CO-5: Communicate effectively, both orally and in written form, to present project findings.

			methodologies, and results to technical and non-technical audiences in a clear and concise manner.
3	M-DS-15	ELECTIVE-3 (HPCA)	CO-1: Analyze and evaluate the architectural principles and design techniques used in High-Performance Computing and Analytics (HPCA) systems. CO-2: Apply advanced optimization and parallelization techniques to enhance the performance of data-intensive applications in HPCA systems. CO-3: Develop and implement efficient algorithms for processing and analyzing large-scale datasets in HPCA environments, considering factors such as data locality, load balancing, and scalability. CO-4: Design and deploy distributed computing frameworks and platforms to support high-performance data processing and analytics tasks in HPCA systems. CO-5: Assess and compare the performance of different HPCA architectures and systems, considering factors such as throughput, latency, power consumption, and scalability, to make informed decisions regarding system selection and configuration.
	M-DS-16	OPTIMIZATION TECHNIQUES	CO-1: Apply various optimization techniques to solve complex real-world problems in the field of data science. CO-2: Analyze and evaluate different optimization algorithms, models, and frameworks to select the most suitable approach for a given problem. CO-3: Design and implement efficient optimization strategies for large-scale data sets, considering computational constraints and resource utilization. CO-4: Evaluate the performance and effectiveness of optimization techniques by conducting experiments, analyzing results, and comparing with baseline methods. CO-5: Critically assess the limitations and trade-offs associated with different optimization techniques and propose modifications or enhancements to improve their efficiency and applicability in data science scenarios.

S.No.	CourseCode	CourseTitle	CourseOutcomes
FourthSemester			
1	M-DS-15	Dissertation	CO-1: Demonstrate the ability to critically analyze research problems in the field of data science, identify appropriate research questions, and formulate a well-defined research objective for a dissertation. CO-2: Apply advanced knowledge and skills in data science to design and implement a research methodology that addresses the identified research problem, utilizing appropriate data collection, analysis, and interpretation techniques.