M. Sc. (Data Science) Programme

Data science is a "concept to unify statistics, data analysis, machine learning and their related methods" in order to "understand and analyze actual phenomena" with data. In other words, the detailed study of the flow of information from structured and unstructured data available with an organization is called data science. It primarily involves obtaining the meaningful insights from the data which is processed through analytical study. The current era is becoming a digital space where each organization deals with large amount of structured and unstructured data on a daily basis. Evolving technologies are leading to cost saving solutions for storage and analysis of such large data. In the current era, for the career progression, one needs to understand the language of data through analytical skill. Hence, it is absolutely necessary nowadays, to develop manpower with a skill to perform data analysis to get meaningful information from the data of different domains such as banking and finance, insurance, agriculture, healthcare, retail, education, social media, manufacturing, transportation, entertainment and so on. As reported recently, with nearly 100,000 vacancies, India is the second biggest data analytics jobs hub after the US and demand for data science skill sets is increasing at a very fast pace.

The field of data science has witnessed an immense growth in recent years particularly due to the rise of internet and social media. The exploration of data science by the business world initially started with analysis of business data and hence emphasis was given for financial data analytics. With the increase of multimedia data such as image, video, audio and text, each domain as mentioned above, many a times needs to perform analysis of such multimedia big data. Hence the study of data science includes analysis of multimedia data along with other types of data such as business data and unstructured social media data. In our daily life, now we are capturing data from sources such as i) sensors used in various places like agricultural fields, shopping malls, ii) posts on social media, iii) digital images and videos captured in cell phones and iv) purchase transactions made through e-commerce. Analysis of such big data which could be multimodal in nature is a huge challenge. Modern technologies in the areas of artificial intelligence (AI) and machine learning (ML) are now extensively used to get insights of such big data.

With the availability of modern technologies of data storage, cleaning and computing, the study of data science expanded beyond the boundaries of mathematics and statistics. In modern days the study of data science is constituted with the knowledge of mathematics, statistics and computer science. Data science brings together a lot of
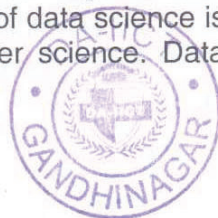
skills of these disciplines with adequate domain knowledge to help any organization find ways to i) take major business decisions, ii) reduce costs, iii) get in to new markets, iv) launch a new product or service, v) find the sentiment of the customers, vi) recruiting the best talent and so on.

With all these in mind, our new master's program in Data Science (launched in 2020), not only includes traditional data analysis skills but also incorporates other crucial skills to perform multimedia and big data analysis. The courses focus on acquiring fundamental knowledge of mathematics, statistics, computer science and machine learning. The curriculum also includes domain specific knowledge by incorporating courses in multimedia, business and finance. Techniques such as data processing, database management, deep learning, data visualization along with tools such as Python, R, and Tableau are also included to enhance the technical and analytical skills. Value Added Courses are offered during the program to make the students hands-on with the challenges of data science and to enable students with industry ready skills. In essence, MSc. in Data Science program has been designed to provide students with a strong foundation in data management and analysis, and the necessary skills to succeed in data science and data-analytics related job.
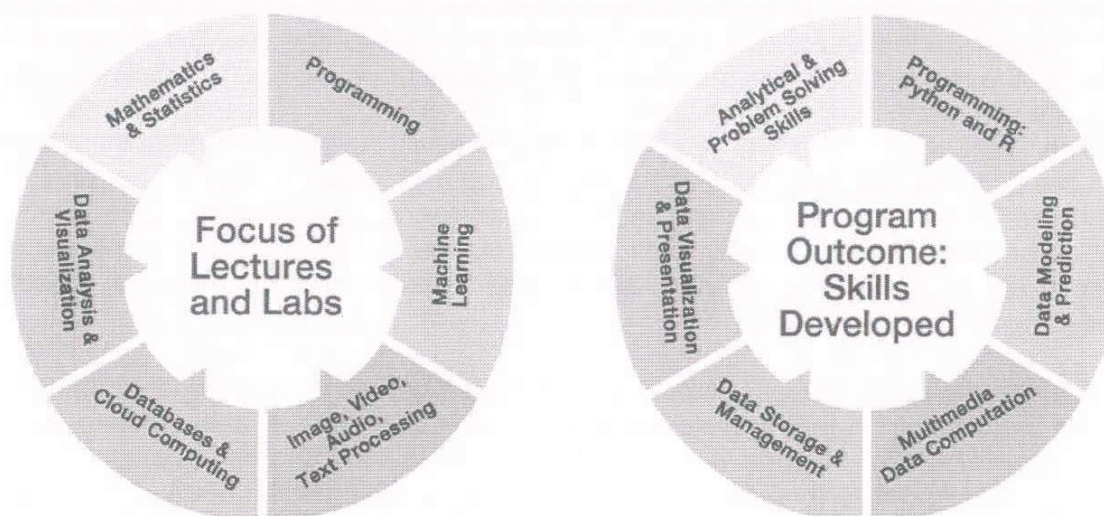
The program primarily aims to cater to the following audience:

1. Traditional Science/ Economics/ Engineering Graduates with good mathematical aptitude, basic programming skills and inclination towards data science.

2. Professionals in the workplace who wish to improve their skills for the emerging jobs in data-science related fields

Programme Outcomes (POs)

As stated by NBA, POs represent the knowledge, skills and attitudes the students should have acquired at the end of the programme.

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: 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.

PO6: 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.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to
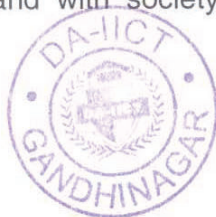
comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **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.

PO12: **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.

Programme Specific Outcomes (PSOs)

PSO1: To model computational problems by applying mathematical concepts and solving real-world problems using algorithmic techniques.

PSO2: To apply the mathematical and statistical approaches for analyzing, designing and development of computing systems in interdisciplinary applications.

Programme Educational Objectives (PEOs)

PEO1: To prepare students with interdisciplinary domain knowledge for data science and analytics.

PEO2: To prepare students with technical kills and hands-on experience on how (and where) to use statistical inferences and their applications in various domains.

PEO3: To prepare graduates with the necessary background for quantitative analysis and technical skills to work professionally with industry and research organizations.

PEO4: To prepare students who will be socially responsible citizen with ethical and leadership qualities and effective interpersonal skills.

Courses

AUTUMN SEMESTER (SEMESTER 1)

Course Name	Credits (L-T-P-C)
Mathematical Foundation for Data Science	4 Credits (3-1-0-4)
Data Structures and Algorithms *(Lab:Python)*	4 Credits (3-0-2-4)
Statistical Methods *(Lab:R)*	4 Credits (3-0-2-4)
Programming Lab	2 Credits (0-0-4-2)
Introduction to Database Management	4 Credits (3-0-2-4)

Total = 18 Credits

WINTER SEMESTER (SEMESTER 2)

Machine Learning	4 Credits (3-0-2-4)
Numerical Methods for Data Science	4 Credits (3-0-2-4)
Big-Data Processing	3 Credits (2-0-2-3)
Mini Project -1*	3 Credits (0-0-6-3)
Optimization	3 Credits (2-0-2-3)
Technical Elective-1	4 Credits (3-0-2-4)

Total = 21 Credits

SUMMER SEMESTER

Value Added Courses (Pass/ Fail)

AUTUMN SEMESTER (SEMESTER 3)

Course Name	Credits (L-T-P-C)
Deep Learning	4 Credits (3-0-2-4)
Interactive Data Visualization	4 Credits (3-0-2-4)
Open Elective-1	3 Credits (3-0-0-3)
Technical Elective-2	3/ 4 Credits
Mini Project -2*	3 Credits (0-0-6-3)
	Total = 17/18 Credits

*Mini Project (to be executed in two phases 1 and 2) will start in second semester and will continue till the end of third semester. Students are expected to work on Mini Project during summer semester also.

WINTER SEMESTER (Semester 4):

Full time On-Campus Projects / Industry Internships

Total 16 Credits (Pass/ Fail)

List of Technical Electives

• Image Processing	• Information Retrieval
• Computational Finance	• No SQL Databases
• Cloud Computing	• Information Systems Security
• Natural Language Processing	• Computer Vision
• Financial/ Business Data Analysis	• Data Warehousing and Data Mining
• Statistical Foundation for Data Science	• Speech Processing

Executive Registrar
DA-IICT, Gandhinagar