Course Curriculum for M. Sc.

in

Data Science

(For students admitted in 2025-27 onwards)

National Institute of Technology Arunachal Pradesh

INSTITUTE VISION

"Our vision is to impart quality technical education with strong underpinning of sound knowledge in the domain. Our approach is interactive, innovative and quintessentially holistic. Our goal is to produce imaginative entrepreneurs, technology leaders of the new millennium and researchers with a profound sense of humanistic and ethical values."

INSTITUTE MISSION

"Our mission is that of producing such Technical Engineers who will not run after jobs , but for whom jobs will run after them, and such that they will create employment and develop new technologies for a faster, sustainable and inclusive growth."

DEPARTMENT VISION

"To provide quality undergraduate and post graduate education in theoretical foundation of science and technology."

DEPARTMENT MISSION

"To make frequent outreach programmes for training locals in their Educations as well as infrastructure developments and to generate funds for sustainable development of the Institute by bringing more research projects."

Programme Educational Objectives (PEOs)

The major objectives of the M.Sc. Programme in 'Data Science' are:

- *To understand and learn the core principles of Mathematics in Data Science*
- *To nurture the coding skills for Data Science*
- *To learn the physical and analytical significance of the problems to be solved*
- *To learn subjects which will help in smooth transition to job market and research fields*
- *To keep with latest trends in industries*

Programme Outcomes (PEOs)

The students who have undergone M.Sc. Programme in 'Data Science' are able to:

1. *Develop a strong foundation in data science concepts, including statistics, machine learning, data analytics, and computational tools to solve real-world problems effectively.*
2. *Engage in research, innovation, and higher studies by applying advanced data science methodologies and tools in interdisciplinary domains.*
3. *Achieve successful careers in industry, academia, or entrepreneurship through lifelong learning and continuous skill development in emerging technologies.*
4. *Demonstrate professional and ethical responsibility in data handling, analysis, and interpretation, ensuring transparency and respect for privacy.*
5. *Exhibit strong communication, teamwork, and leadership skills to collaborate effectively in diverse professional settings and contribute meaningfully to organisational and societal goals.*

Sl. no.	Course code	Course Title	L	T	P	C
1.	MS1101	Optimization Theory and Applications	3	1	0	3
2.	MS1102	Advanced Algebra	3	0	0	3
3.	MS1103	Differential Equations	3	0	0	3
4.	MS1104	Discrete Mathematics	3	0	0	3
5.	MS1105	Probability and Statistics	3	0	1	4
6.	MS1106	Scientific Computing	3	0	1	4
Semester – II						**20**
7.	MS1201	Introduction to Data Science	3	0	0	3
8.	MS1202	Artificial Intelligence and Machine Learning	3	0	1	4
9.	MS1203	Data Structures and Algorithms	3	0	1	4
10.	MS1204	Quantum Computing	3	0	0	3
11.	MS1205	Mathematical Modelling and Simulations	3	0	1	3
12.	MS1206	Statistical Regression	3	0	0	3
Semester – III						**20**
13.	MS2101	Number Theory and Cryptography	3	0	0	3
14.	MS2102	Business Analytics	3	0	0	3
15.	MS2103	Industrial Electives-I	3	0	0	3
16.	MS2104	Industrial Electives-II	3	0	0	3
17.	MS2105	Quantitative Finance	3	0	1	4
18.	MS2106	Generative AI	3	0	1	4
Semester - IV						**20**
19.	MS2201	Elective (Online or NPTEL or as faculty advisor)				4
20.	MS2202	Internship/Project				10
						74

Elective Courses:

S. No.	Topics	Credits
1	Classical Fluid dynamics	3
2	Measure Theory (Real & Functional)	3
3	River modeling/Fluvial sedimentation modeling	3
4	Statistical mechanics	3
5	Climate change modeling	3
6	Portfolio theory and Risk Management	3
7	Thin films	3
8	Plasma Physics	3
9	Particle Dynamics	3

10	Statics	3
11	Glaciers Modeling	3
12	Hypersonic fluid flow	3
13	Computational Chemistry	3
14	Bayesian Neural Networks	3
15	Gaussian Process	3
16	Generative Models	3
17	Energy based methods	3
18	Diffusion models	3
19	Reinforcement learning	3
20	High Performance Computing	3
21	Deep Learning for the Life Science	3
22	Graph Theory	3
23	Complex Network Analysis	3
24	Course suggested by Instructor with students consent from NPTEL or other institute recognized MOOC's portal or Physical mode course.	3

Eligibility: B. Sc. (Physics/Mathematics/Computer Science/Data Science) & B. Tech. or equivalent

M SC DATA SCIENCE S SYLLABUS

	राष्ट्रीयप्रौद्योगिकीसंस्थानअरुणाचलप्रदेश **NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH** (शिक्षामंत्रालय, भारत सरकारकेतहतराष्ट्रीयमहत्वकासंस्थान) (Institute of National Importance under Ministry of Education, Govt. of India)				**CURRICULUM**

Programme	M.Sc. Data Science		Academic Year of Regulation	**2025-26**
Department	Basic and Applied Science		Semester	**I**

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
MS1101	Optimization Theory and Application	3	0	0	3	20	30	50	100		

Course Objectives	To learn various optimization techniques involved in data science	Course Outcomes	CO1	(i) After going through this course the students will be able to formulate problems in optimization techniques	*Understanding/ Comprehension*
			CO2	(ii) Solve using Optimization techniques	*Identify/ Knowledge/ Remember*
			CO3	(iii) Implement and extend it to real world scenario	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes(POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS

No.	Content	Hours	COs
I	Mathematical foundations and concepts of linear optimization, simplex method, revised simplex method, duality, sensitivity analysis.	10	CO1, CO2, CO3
II	Basic descent methods: Line search methods, steepest descent, and Newton methods; Constrained optimization: first order necessary conditions, second order necessary conditions, Karush-Kuhn-Tucker (KKT) conditions, constraint qualification.	10	CO1, CO2, CO3
III	Convex programming problem; Dynamic programming; Quadratic programming: Active set methods, gradient projection methods and sequential quadratic programming.	10	CO1, CO2, CO3
IV	Goal Programming: Concept of goal programming, model formulation, graphical solution method; multi-objective programming; Interior point methods; Karmarkar's algorithm.	10	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. S. S. Rao, Optimization: Theory and Applications, Halsted Press, 1984.
2. Rajesh Kumar Arora, Optimization: Algorithms and Applications, Chapmann and Hall, 2015

Reference Books:

1. Stephen P. BoydStephen P. Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University, 2016
2. Hamdy H. Taha, Operations Research: A Introduction, Pearson Publications, 2007

		CURRICULUM

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Programme	M.Sc. Data Science	Academic Year of Regulation	2025-26
Department	Basic and Applied Science	Semester	I

Course Code	Course Name	Credit Structure					Marks Distribution			
		L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
MS1102	Advanced Algebra	3	0	0	3	20	30	50	100	

Course Objectives	To learn the concepts in Advanced Algebra	Course Outcomes	CO1	i) To learn the concepts of Advanced Algebra	*Understanding/ Comprehension*
			CO2	ii) To understand to think in abstract way	*Identify/ Knowledge/ Remember*
			CO3	iii) Advance the concept in Advanced Algebra	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes(POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	Introduction to group, subgroup, permutation group, cyclic group, order of the group, rings, subrings, ideal.	10	CO1, CO2, CO3
II	Vector spaces, subspaces, basis and dimension, coordinates, algebra of linear transformations, isomorphisms, representation of linear transformations by matrices, linear functionals.	10	CO1, CO2, CO3
III	Characteristic values and characteristic polynomials, diagonalizable transformations, Cayley-Hamilton theorem, primary decomposition theorem.	10	CO1, CO2, CO3
IV	Inner product spaces, adjoints, unitary and normal transformations, spectral Theorem, Jordan canonical form. Triangle inequality and Cauchy-Schwarz Inequality, Orthogonality of vectors, Orthonormal basis, Gram-Schmidt Process of orthonormalization, orthogonal complement.	10	CO1, CO2, CO3
Total Hours		40	

Text Books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern, New Delhi.

2. Gilbert Strang – Fundamentals of Linear Algebra, Cambridge University Press (2007)

Reference Books:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University Press

2. N. Jacobson, Basic Algebra, vol. II & VIII, Hindustan Publishing Company

3. S. Lang, Algebra, Addison- Wesley.

4. I. S. Luther & I.B.S. Passi Algebra Vol-1,2,3, Narosa company

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Programme	M.Sc. Data Science					Academic Year of Regulation			2025-26
Department	Basic and Applied Science					Semester			I

Course Code	Course Name	Credit Structure				Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	

Course Code	Course Name	L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
MS1103	Differential Equations	3	0	0	3	20	30	50	100	

Course Objectives	The students will learn the governing mathematical formulations and their solutions of various physical problems.	Course Outcomes	CO1	After going through this course the students will be able to (i) Formulate the governing Mathematical equations of Physical Problems.	*Understanding/ Comprehension*
			CO2	(ii) Solve Differential Equations using various Mathematical tools.	*Identify/ Knowledge/ Remember*
			CO3	The subject Partial Differential equations have wide range of applications in engineering and technological sciences. Using Partial Differential equations, students can solve wave equations, heat equations, Laplace equations etc	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS

No.	Content	Hours	COs
I	**Unit I: Ordinary Differential Equations**: Series solutions of second order linear differential equations, Legendre equation and Legendre polynomials, Bessel equation and Bessel functions, Systems of first-order linear differential equations.	10	CO1, CO2, CO3
II	**Unit II: Partial Differential Equations of Second Order:** Liner partial differential equations of second order with constant co-efficient, Characteristic curves of second order equations, Reduction to canonical forms, Separation of variables.	10	CO1, CO2, CO3
III	**Unit III. Laplace's Equation, Wave Equation, Diffusion Equation:** The occurrence of Laplace's equation in Physics, Elementary solutions of Laplace's equation, Boundary value problem, Solution of Laplace's equation by separation of variables, The occurrence of the Wave equation in Physics, Elementary solutions of the one-dimensional Wave equation, Solution of the Wave equation by separation of variables The occurrence of the Diffusion equation in Physics, Elementary solutions of the Diffusion equation, Solution of the Diffusion equation by separation of variables.	10	CO1, CO2, CO3
IV	**Unit IV: Methods of Green's Function**: Green's Function, Green's Function for the Laplace's equation, Green's Function for the Wave equation, Green's Function for the Diffusion equation.	10	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. Ross, S. L. (1984), Differential Equations, Wiley India.
2. Coddington, E. A. (2001), An Introduction to Ordinary Differential Equations, PHI.
3. Sneddon, I. N. (2006), Elements of Partial Differential Equations, Dover Publications, Inc.
4. Rao, K. S. (2010), Introduction to Partial Differential Equations, PHI Learning Pvt. Ltd..

Reference Books:

5. Boyce, W. E., DiPrima, R. C. (2009), Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India

6. Piaggio, E. T. H. (1985), Differential Equations, CBS Publishers and Distributors

7. Bhamra, K. S. (2010), Partial Differential Equations, PHI Learning Pvt. Ltd.

8. Ayres, F (Jr.). (1972), Theory and Problems of Differential Equations, SI (Metric) Edition,Schaum Outline Series. McGraw Hill Book Co.

9. Website and E-learning Source: http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org

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CURRICULUM

Programme	M.Sc., Data Science	Academic Year of Regulation			2025-26			
Department	Basic and Applied Science	Semester			I			

Course Code	Course Name	Credit Structure				Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS 1104	Discrete Mathematics	3	0	0	3	20	30	50	100	

Course Objectives	1. To extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems 2. Apply logical reasoning to solve a variety of problems.	Course Outcomes	CO1	Understand the basic concepts of set and counting, relation and function, group and ring, discrete numeric function and generating function, recurrence relation and recursive algorithm, boolean algebra and graph theory.	*Understanding/ Comprehension*
			CO2	Describe the properties of set and counting, relation and function, group and ring, discrete numeric function and generating function, recurrence relation and recursive algorithm, boolean algebra and graph theory.	*Identify/ Knowledge/ Remember*
			CO3	Solve the fundamental problems related to discrete structure.	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	Sets and Properties: Finite and Infinite Sets, Combinations of Sets, Countable and uncountable Sets, Mathematical Induction, Principle of Inclusion and Exclusion, Pigeonhole Principles, Propositional logic. Relations and Functions: Properties of Binary Relations, Equivalence Relations and Partitions, Partial Ordering, Partial order relation, Relations and Lattices.	10	CO1, CO2, CO3
II	Group and Rings: Groups, Subgroups, Permutation Groups, Cyclic group, Cosets and Lagrange's Theorem, Rings, Integral Domains and Fields	10	CO1, CO2, CO3
III	Discrete Numeric Functions and Generating Functions: Manipulation of Numeric Functions, Asymptotic Behavior of Numeric Functions, Generating Functions. Recurrence Relations and Recursive Algorithms: Recurrence Relations, Linear Recurrence Relations with Constant Coefficients. Boolean Algebra: Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic System,	10	CO1, CO2, CO3
IV	Graph Theory: Basic concepts, Graph isomorphism, Bipartite graph, Subgraph, Degree, Walk, Path, Cycle, Connectivity. Cut vertices and cut edges, Trees, Binary tree, Spanning trees, Euler graph, Euler tours and Hamiltonian cycles.	10	CO1, CO2, CO3
Total Hours		40	

Text Books:

1 C.L. Liu, "Elements of Discrete Mathematics", McGraw Hill Education; 4th edition, 2017.

2. D.S. Malik and M. K. Sen, Discrete Mathematical Structures: Theory and Applications, Cengage; 1st edition, 2012.

Reference Books:

1. K. H. Rosen, Discrete Mathematics and its Applications, McGraw Hill Education; 7th edition, 2017.

2. Kolman B, Busby R. C, Ross S.C, "Discrete Mathematical Structures", PHI Learning, 2011.

3. S. Lipschutz, Marc L. Lipson, "Discrete Mathematics", Schaum's outlines, Print, 3th edition, 2013.

4. Norman L. Biggs, "Discrete Mathematics", Oxford, 2nd Edition, 2009

5. Rowan Garnier& John Taylor, "Discrete Mathematics", Oxford, 2nd Edition,2009.

6. R. Johnsonbaugh, "Discrete Mathematics", Pearson, 8th Edition, 2017.

7. N. Deo, with Applications to Engineering and Computer Science, Prentice Hall India Learning Private Limited; 9th edition, 1979.

8. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, McGraw Hill Education; 1st edition, 2017.

9. T. Koshy, Discrete Mathematics with Applications, Academic Press Inc, 2014.

10. I. N. Herstein, Topics in Algebra, Wiley India Pvt. Ltd., 2006

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Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		I

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS1105	Probability and Statistics	3	0	0	3	20	30	50	100	

Course Objectives	1. Students will be well versed in converting Mathematical and Physical concepts taught in the class into programming code. 2. Will know the details of computational coding.	Course Outcomes	CO1	Will learn Computer coding.	*Understanding/ Comprehension*
			CO2	Will learn to convert Mathematical and Physical concepts arising in classroom to programming	*Identify/ Knowledge/ Remember*
			CO3	Will get know the details and finer parts of computational coding.	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS

No.	Content	Hours	COs
I	**Programming for Probability and Data Analysis** Domains and probabilities - Stochastic variables and the main concepts, the discrete case - Properties of PDFs - Expectation values - Probability Distribution Functions - Uniform distribution - The exponential distribution - covariance	6	CO1, CO2
II	**Sampling and Estimation** Introduction to Sampling - Population Parameters and Sample Statistic - Sampling - Probabilistic Sampling - Non-Probability Sampling - Sampling Distribution - Central Limit Theorem (CLT) - Concepts and Applications	6	CO1, CO2, CO3
III	**Confidence Intervals** Introduction to Confidence Interval - Confidence Interval for Population Mean - Confidence Interval for Population Proportion - Confidence Interval for Population Mean When Standard Deviation is Unknown - Confidence Interval for Population Variance	14	CO1, CO2, CO3
IV	**Hypothesis Testing** Introduction to Hypothesis Testing - Difference In Two Population - Means When Population Standard Deviations are Unknown and not Equal: Two-sample t-Test with Unequal Variance in Population Proportion under Large Samples: Two-Sample Z-Test for Proportions - Effect Size: Cohen's D - Hypothesis Test for Equality of Population Variances - Non-Parametric Tests: Chi-Square Tests - Chi-Square Goodness of Fit Tests - Choice of Number of Intervals in Chi-Square Goodness of Fit Test - Chi-Square Test of Independence	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, Ninth Edition, Prentice Hall, 2011
2. U. Dinesh Kumar, Business Analytics, Wiley, 2017 & Series.

Reference Books:

1. Johannes Ledolter, Data mining and business analytics with R
2. Galit Shmueli Galit Shmueli, Peter C. Bruce, Amit V. Deokar, Nitin R. Patel, Machine learning for Business Analytics with Python, Wiley, 2023
3. Manoranjan Pradhan, U Dinesh Kumar, Machine learning using Python, Wiley, 2018
4. Peyton Z. Peebles, Probability Random Variables, and Signal Principles, McGraw Hill Inc., 2001
5. Jim Pitman, Probability, Springer, 1993

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		I

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
MS1106	Scientific Computing	3	0	0	3	20	30	50	100		

Course Objectives	1. Students will be well versed in converting Mathematical and Physical concepts taught in the class into programming code. 2. Will know the details of computational coding.	Course Outcomes	CO1	Will learn Computer coding.	*Understanding/ Comprehension*
			CO2	Will learn to convert Mathematical and Physical concepts arising in classroom to programming	*Identify/ Knowledge/ Remember*
			CO3	Will get know the details and finer parts of computational coding.	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

	SYLLABUS		
No.	Content	Hours	COs
I	**Programming for Probability and Data Analysis** Domains and probabilities - Stochastic variables and the main concepts, the discrete case - Properties of PDFs - Expectation values - Probability Distribution Functions - Uniform distribution - The exponential distribution - covariance	6	CO1, CO2
II	**Linear Algebra, Handling of Arrays and Python** Matrix and vector handling packages – Matrices - Numpy and arrays - Matrix and Vector Operations - Gaussian Elimination - LU Decomposition, the inverse of a matrix	6	CO1, CO2, CO3
III	Linear Regression – Ridge and Lasso Regression – Resampling Method – Logistic Regression – Optimization – Support Vector Machines – Decision Trees – Ensemble Methods	14	CO1, CO2, CO3
IV	Basic ideas of the Principal component analysis (PCA) – Clustering and Unsupervised learning – Neural Networks – Building a Feed Forward Neural Network - Convolutional Neural Networks – Recurrent Neural Networks	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022

2. Thomas Nield, Essential Math for Data Science, Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics, O'Reilly, 2022

Reference Books:

1. Pradeep Singh, Fundamentals and Methods of Machine and Deep Learning, Algorithms, Tools and Applications, Wiley 2022

2. Tong Zhang, Mathematical Analysis of Machine Learning Algorithms, Cambridge University Press, 2023.

3. Yuxi (Hayden) Liu, Python Machine Learning By Example, Packt, 2020.

4. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt, 2017.

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation			2025-26	
Department	Basic and Applied Science		Semester			II	

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS1201	Introduction to Data Science	3	0	0	3	20	30	50	100	

Course Objectives	1. Students will be well versed in concepts of Data Science 2. Students will be know the directions to the solutions of the problems.	Course Outcomes	CO1	Will learn concepts of Data Science	Understanding/ Comprehension
			CO2	Will learn the connection between Mathematics and Data	Identify/ Knowledge/ Remember
			CO3	Will get know how to apply the learnt concepts to data and make useful conclusions from data.	Understanding/ Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	A Basic Linear Regression - Residuals and Squared Errors - Finding the Best Fit Line - Closed Form Equation - Inverse Matrix Techniques - Gradient Descent - Overfitting and Variance - Stochastic Gradient Descent - The Correlation Coefficient - Statistical Significance - Coefficient of Determination - Standard Error of the Estimate - Prediction Intervals - Train/Test Splits - Multiple Linear Regression	6	CO1, CO2
II	Understanding Logistic Regression - Performing a Logistic Regression - Logistic Function - Fitting the Logistic Curve - Multivariable Logistic Regression - Understanding the Log-Odds - R-Squared - P-Values - Train/Test Splits - Confusion Matrices - Bayes' Theorem and Classification - Receiver Operator Characteristics/Area Under Curve - Class Imbalance - Conclusion	6	CO1, CO2, CO3
III	Neural Networks and Deep Learning - A Simple Neural Network - Activation Functions - Forward Propagation - Backpropagation - Calculating the Weight and Bias Derivatives - Stochastic Gradient Descent - Using scikit-learn - Limitations of Neural Networks and Deep Learning - Conclusion	14	CO1, CO2, CO3
IV	Data Science - A Brief History of Data Science - Finding Your Edge - SQL Proficiency - Programming Proficiency - Data Visualization - Knowing Your Industry - Productive Learning - Practitioner Versus Advisor - What to Watch Out For in Data Science Jobs	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. Tamoghna Ghosh, Shravan Kumar Belagal Math, Practical Mathematics for AI and Deep Learning, BPB Publications, 2023
2. Ivan Vasilev, Advanced Deep Learning with Python, Packt Publications, Birmingham – Mumbai, 2019

Reference Books:

1. François Chollet, Deep learning using Python, Manning, 2017
2. Rowel Atienza, Advanced Deep Learning with TensorFlow 2 and Keras, Packt Publications, Birmingham – Mumbai, 2020
3. Otmar Scherzer, Bernd Hofmann, Zuhair Nashed, Gauss Newton method for solving linear inverse problems with neural network coders, Sampling Theory, Signal Processing, and Data Analysis, 2023, 21:25, Birkhãuser. https://doi.org/10.1007/s43670-023-00066-6
4. https://en.wikipedia.org/wiki/Universal_approximation_theorem
5. https://www.geeksforgeeks.org/universal-approximation-theorem-for-neural-networks/
6. https://mitliagkas.github.io/

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		II

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS2102	Business Analytics	3	0	0	3	20	30	50	100	

Course Objectives	1. To know the concepts of Statistics applied in business environment 2. To make decisions using concepts of Statistics and apply in Industrial scenario	Course Outcomes	CO1	Will learn concepts of Statistics used in Business world	*Understanding/ Comprehension*
			CO2	Will learn to forecast the future scenario	*Identify/ Knowledge/ Remember*
			CO3	Will get know various techniques to use in different real time cases	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	**Analysis of Variance** Variance (ANOVA)- Multiple t-Tests for Comparing Several Means - One-way Analysis of Variance (ANOVA) - Setting Up an Analysis of Variance - Cochran's Theorem - The F-Test - Two-Way Analysis of Variance (ANOVA)	6	CO1, CO2
II	**Decision Trees** Decision Trees: Introduction - Chi-Square Automatic Interaction Detection (CHAID) - CHAID Tree Development - Bonferroni Correction - Generating Business Rules using CHAID Tree - Classification and Regression Tree - Gini Impurity Index -	8	CO1, CO2, CO3
III	**Forecasting Techniques** Introduction to Forecasting - Time-Series Data and Components of Time-Series Data - Forecasting Techniques and Forecasting Accuracy - Mean Absolute Error (MAE) - Mean Absolute Percentage - Error (MAPE) - Mean Square Error (MSE) -Root Mean Square Error (RMSE) - Moving Average	12	CO1, CO2, CO3
IV	**Stochastic Models** Introduction Stochastic Process - Poisson Process - Compound Poisson Process - Markov Chains - Classification of States in a Markov Chain - Markov Chains with Absorbing States	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. U. Dinesh Kumar, Business Analytics, The Science of Data-Driven Decision Making, Wiley, 2017

2. Manaranjan Pradhan, U Dinesh Kumar, Machine learning using Python, Wiley, 2019.

Reference Books:

7. François Chollet, Deep learning using Python, Manning, 2017

8. Rowel Atienza, Advanced Deep Learning with TensorFlow 2 and Keras, Packt Publications, Birmingham – Mumbai, 2020

9. Otmar Scherzer, Bernd Hofmann, Zuhair Nashed, Gauss Newton method for solving linear inverse problems with neural network coders, Sampling Theory, Signal Processing, and Data Analysis, 2023, 21:25, Birkhãuser. https://doi.org/10.1007/s43670-023-00066-6

10. https://en.wikipedia.org/wiki/Universal_approximation_theorem

11. https://www.geeksforgeeks.org/universal-approximation-theorem-for-neural-networks/

12. https://mitliagkas.github.io/

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CURRICULUM

Programme	M.Sc. Data Science			Academic Year of Regulation			2025-26
Department	Basic and Applied Science			Semester			II

Course Code	CourseName	CreditStructure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS1203	Data Structures and Algorithms	3	0	0	3	20	30	50	100	

Course Objectives	1. Students will understand the basics of Advanced concepts of Probability and Statistics. 2. Apply the above knowledge to understand problems in real world with programming knowledge.	Course Outcomes	CO1	Understand the advanced concepts of Probability and Statistics.	*Understanding/ Comprehension*
			CO2	Describe the links between the concepts learnt and real time data	*Identify/ Knowledge/ Remember*
			CO3	To write programming code for the learnt Probability and Statistics concepts	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Data Structures and Algorithms** Data Structures – Elementary Data Organization, Classification of Data Structures, Operations on Data Structures, Abstract Data Types Analysis of Algorithm – The Big-Oh, Big-Omega, Big-Theta, Small-Oh, Small-Omega **Recursion** Analyzing Recursive Algorithms – Designing Recursive Algorithms	6	CO1, CO2, CO3
II	**Array-Based Sequences** Low level Arrays – Dynamic Arrays – Array Based Sequences **Stacks** Stack Abstract Data Type – Simple Array Based Stack Implementation	6	CO1, CO2, CO3
III	**Queues & Linked Lists** Queue Abstract Data Type – Array Based Queue – Double Ended Queue – Circular Queue - Singly Linked Lists – Circularly Linked Lists – Doubly Linked Lists	14	CO1, CO2, CO3
IV	**Trees, Maps, Hash Tables, Sets & Sorting and Graph Algorithms** Binary trees – Tree Traversal Algorithms – Maps & Dictionaries – Hash Tables – Sorted Maps – Sets – Sorting and Graph Algorithms	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Subhrakanta Panda, Data Structures and Algorithms in Python, Wiley, 2024

4. Clifford A. Shaffer, Data Structures and Algorithm Analysis in Java, Dover Publications, 2017

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in Java, Pearson, 2012

2. Jay Wengrow, A Common-Sense Guide to Data Structures and Algorithms, The Pragmatic Self, 2017

3. https://www.geeksforgeeks.org/dsa-tutorial-learn-data-structures-and-algorithms/

4. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

5. https://onlinecourses.nptel.ac.in/noc25_cs148/preview

6. Mingyuan Li, Duan Wang, Erick Purwanto, Thomas Selig, Qing Zhang, Hai-Ning Liang, VisualCodeMOOC: A course platform for algorithms and data structures integrating a conversational agent for enhanced learning through dynamic visualizations, SoftwareX, Vol. 30, May 2025, 102072

7. Maodong Pan, Ruijie Zou, Bert Jüttler, Algorithms and data structures for C^s-smooth RMB-splines of degree $2s + 1$, Volume 114, November 2024, 102389

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		**II**

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS1204	Quantum Computing	3	0	0	3	20	30	50	100	

Course Objectives	1. To know the concepts of linking Quantum Mechanics and Quantum Computing 2. To know the concepts of Quantum Computing	**Course Outcomes**	CO1	Will learn concepts of Quantum Mechanics	*Understanding/ Comprehension*
			CO2	Will learn how the concepts in Quantum Computing	*Identify/ Knowledge/ Remember*
			CO3	Will get to know the connection between Physics and Computing	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	**Quantum Mechanics** Physical Background - The Double-Slit Experiment - Wave Functions - State Space - The Schrödinger Equation	6	CO1, CO2
II	**One Qubit** Introducing quantum bits - Bras and kets- The complex math and physics of a single qubit - Quantum state representation - Unitary matrices mapping to standard form - The density matrix - Observables and expectation - A non-linear projection - The Bloch sphere – Pauli Gate - The quantum **X** gate - The quantum **Z** gate - The quantum **Y** gate - The quantum **ID** gate - The quantum **H** gate - The quantum **Rz** gates - The quantum **S** gate - The quantum **Sy** gate - The quantum **T** gate - The quantum **Ty** gate - The quantum **Rx** and **Ry** gates - The quantum under root **NOT** gate	12	CO1, CO2, CO3
III	**Two and Three Qubits** Tensor products - Entanglement - Multi-qubit -–Constructing a circuit-Amplitude amplification – Searching -The Deutsch-Jozsa algorithm - Simon's algorithm	12	CO1, CO2, CO3
IV	**Quantum Fourier Transform** Factoring - Phase estimation -Order and period finding - Shor's algorithm - Light and photons – Decoherence - Error correction - Quantum Volume - The software stack and access – Simulation – Future prospects of Quantum computing	10	CO1, CO2, CO3
	Total Hours	40	

Text Books

1. Ajit Kumar, Fundamentals of Quantum Mechanics, Cambridge Press University, 2018

2. Robert S. Sutor, Dancing with Qubits, Packt, 2019

Reference Books

1. Anshul Saxena, Javier Mancilla, Iraitz Montalban, Christophe Pere, Financial Modeling Using Quantum Computing, Packt, 2023

2. Venkateswaran Kasirajan, Fundamentals of Quantum Computing, Theory and Practice, Springer, 2021

3. Leonard S. Woody III, Mathematics for Quantum Computing, Packt, 2022

4. Wolfgang Scherer, Mathematics of Quantum Computing, An Introduction, Springer, 2019

5. Sarah Kaiser, Chris Granade, Learn Quantum Computing with Python and Q#, Manning, 2022

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		II

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS1205	Mathematical Modelling and Simulation	3	0	0	3	20	30	50	100	

Course Objectives	To learn how model physical problems and use techniques to solve them	Course Outcomes	CO1	i) To learn about the different physical problems	*Understanding/ Comprehension*
			CO2	ii) To learn advanced numerical techniques	*Identify/ Knowledge/ Remember*
			CO3	iii) To learn to solve physical problems using advanced numerical techiques	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	Simulation of III-V Semiconductor Electronics,Energy Storage Devices and Solar Cells	10	CO1, CO2
II	Condensed Matter Physics Simulation and modeling – Material Science	12	CO1, CO2, CO3
III	Fractional Calculus concepts – Simulation	12	CO1, CO2, CO3
IV	Finite difference technique – Advanced Numerical techniques and Visualization	6	CO1, CO2, CO3
Total Hours		40	

Text Books

1. Donald A. Neamen, Semiconductor Physics and Devices- Basic Principles, McGraw Hill Education (India) Private Limited

2. William F. Smith, Javad Hashemi, Dr. Francisco Presuel-Moreno, Foundations of Materials Science and Engineering, McGraw Hill Education (India) Private Limited

Reference Books

1. Keith B. Oldham, Jerome Spanier, The Fractional Calculus: Theory and Applications of Differentiation and Integration to Arbitrary Order, Dover Books on Mathematics.

2. Dale Anderson, John C. Tannehill, Richard H. Pletcher, Ramakanth Munipalli, Vijaya Shankar, Computational fluid mechanics and heat transfer 4ed, CRC Press

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(logo)</td><td colspan="6" rowspan="2" align="center">राष्ट्रीयप्रौद्योगिकीसंस्थानअरुणाचलप्रदेश
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Programme	M.Sc. Data Science				**Academic Year of Regulation**		**2025-26**
Department	Basic and Applied Science				**Semester**		**II**

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's taxonomy**
MS1206	Statistical Regression	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	To learn concepts of Statistical Regression	**Course Outcomes**	CO1	i) To learn about the different concepts of Statistical Regression
				Understanding/ Comprehension
			CO2	ii) To apply the Statiscal Regression to examples
				Identify/ Knowledge/ Remember
			CO3	iii) To apply the Statistical Regression using programming language
				Understanding/ Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	**Content**	**Hours**	**COs**
I	**Linear Regression -** Descriptive Data Analysis - Multiple Linear Regression Models - Simple Linear Regression: One Independent Variable - Multiple Linear Regression: Moderation Analysis	**10**	**CO1, CO2**
II	**Introduction to Multi-Level Modeling -** Multi-Level Data Structure - Intra-Class Correlation - Two-Level MLM - Longitudinal Data and Their Relationship to MLMs	**12**	**CO1, CO2, CO3**
III	**Two-Level Multi-Level Modeling -** The Two-Level MLM - MLM Using *R* Package *nlme* - Model Selection with Likelihood Ratio Chi-Square Test	**12**	**CO1, CO2, CO3**
IV	**Longitudinal Data Analysis -** Data on Breast Cancer Post-surgery Assessment - Graphic Analysis - Longitudinal Models Using Function *lme* from *nlme* Package	**6**	**CO1, CO2, CO3**
	Total Hours	**40**	

Text Books

1. Ding-Geng (Din) Chen, Jenny K. Chen, Statistical Regression Modeling with *R*, Longitudinal and Multi-level Modeling, Springer, 2021

2. Manoranjan Pradhan, U Dinesh Kumar, Machine learning using Python, Springer, Wiley, 2019

Reference Books

1. U. Dinesh Kumar, Business Analytics, Wiley, 2017

2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning: Data Mining, Inference, And Prediction, Second Edition (springer Series In Statistics), Springer, 2019

3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics), Springer, 2017

4. Kevin P. Murphy , Probabilistic Machine Learning: An Introduction, MIT, Press, 2022

5. Aurélien Géron (Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O' Rielly, Series, 2022

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CURRICULUM

Programme	M.Sc., Data Scence	Academic Year of Regulation		2026 - 27
Department	Basic and Applied Science	Semester		III

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS2101	Number Theory and Cryptography	3	0	0	3	20	30	50	100	

Course Objectives	1 Students will understand the basics of Number Theory. 2 Apply the above knowledge to understand Cryptography.	Course Outcomes	CO1	Understand the basic concepts of number theory and cryptography.	*Understanding/ Comprehension*
			CO2	Describe the properties of number theory and cryptography.	*Identify/ Knowledge/ Remember*
			CO3	Solve the fundamental problems related to number theory and cryptography.	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	Preliminaries: The number system and the Well-Ordering Principle and Mathematical Induction. Divisibility and Factorization:Divisibility, Greatest Common Divisors, Euclidean Algorithm, Least Common Multiple. Solving Linear Diophantine Equations.	10	CO1, CO2, CO3
II	Primes: Prime Numbers, Unique Prime Factorization, test of Primality by Trial Division. Theory of Congruences : The concept of congruences, Congruence Classes, Applications of Congruences. Solving Linear Congruences : Solving (single) linear congruence, Solving system of linear congruences, the Chinese Remainder Theorem .	10	CO1, CO2, CO3
III	Fermat's Theorem and Euler's Generalization: Fermat's Little Theorem, the general case: Euler's theorem. Primitive Roots : The multiplicative order, Promitive Roots (mod n), the modulus n which does not have primitive roots , the Existence Theorems and Applications: The use of primitive roots. Quadratic Congruences : Euler's Criterion, the Legendre Symbol and its properties and examples of computing the Legendre symbol, Jacobi Symbol and Quadratic Residues and Primitive Roots.	10	CO1, CO2, CO3
IV	Cryptography : Introduction, Symmetric-key cryptography andAssymetric Key or public key cryptography.	10	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. Harold M. Stark.An Introduction to Number TheoryMarkham Publishing Company, 1970.

2. N. Koblitz. A course in number theory and cryptography. London: Springer Verlag, 1994.

Reference Books:

1. Joseph A. Gallian.*Contemporary*Abstract Algebra 4th Edition Houghton Mifflin Company, 1998,

2. M. Baldoni,C.Ciliberto, G.Cattaneo,& D.Gewurz. Elementary number theory, cryptography and codes. London: Springer, 2009.

3. A. *Bruen* Cryptography, information theory and error correction: A handbook for the 21st century. Hoboken, NJ: Wiley-Blackwell, 2011.

4. M. Herkommer Number theory: A programmer's guide. New York: Osborne/McGraw-Hill, 1998.

5. J. Hoffstein, J. Pipher , & J. Silverman. An introduction to mathematical cryptography (2nd ed.). London: Springer Verlag, 2014.

6. G. JonesElementary number theory. London: Springer Verlag, 1998.

7. D. Kahn, The codebreakers*:* The comprehensive history of secret communication from ancient times to the internet. New York: Simon & Schuster, 1997.

8. K. H. Rosen. Elementary number theory and its applications. New York: Pearson/Addison Wesley, 2010.

9. Swenson, C. (2008). *Modern cryptanalysis: Techniques for advanced code breaking*. New York: John Wiley & Sons.

10.S. Wagstaff. Cryptanalysis of Number Theoretic Ciphers. Chapman and Hall/CRC, 2019.

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Programme	M.Sc. Data Science		Academic Year of Regulation			2026-27	
Department	Basic and Applied Science		Semester			III	

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS2102	Business Analytics	3	0	0	3	20	30	50	100	

Course Objectives	1. To know the concepts of Statistics applied in business environment 2. To make decisions using concepts of Statistics and apply in Industrial scenario	Course Outcomes	CO1	Will learn concepts of Statistics used in Business world	*Understanding/ Comprehension*
			CO2	Will learn to forecast the future scenario	*Identify/ Knowledge/ Remember*
			CO3	Will get know various techniques to use in different real time cases	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

	SYLLABUS		
No.	Content	Hours	COs
I	**Analysis of Variance** Variance (ANOVA)- Multiple t-Tests for Comparing Several Means - One-way Analysis of Variance (ANOVA) - Setting Up an Analysis of Variance - Cochran's Theorem - The F-Test - Two-Way Analysis of Variance (ANOVA)	6	CO1, CO2
II	**Decision Trees** Decision Trees: Introduction - Chi-Square Automatic Interaction Detection (CHAID) - CHAID Tree Development - Bonferroni Correction - Generating Business Rules using CHAID Tree - Classification and Regression Tree - Gini Impurity Index -	8	CO1, CO2, CO3
III	**Forecasting Techniques** Introduction to Forecasting - Time-Series Data and Components of Time-Series Data - Forecasting Techniques and Forecasting Accuracy - Mean Absolute Error (MAE) - Mean Absolute Percentage - Error (MAPE) - Mean Square Error (MSE) -Root Mean Square Error (RMSE) - Moving Average	12	CO1, CO2, CO3
IV	**Stochastic Models** Introduction Stochastic Process - Poisson Process - Compound Poisson Process - Markov Chains - Classification of States in a Markov Chain - Markov Chains with Absorbing States	14	CO1, CO2, CO3
	Total Hours	40	

Text Books:

1. U. Dinesh Kumar, Business Analytics, The Science of Data-Driven Decision Making, Wiley, 2017
2. Manaranjan Pradhan, U Dinesh Kumar, Machine learning using Python, Wiley, 2019.

Reference Books:

1. François Chollet, Deep learning using Python, Manning, 2017
2. Rowel Atienza, Advanced Deep Learning with TensorFlow 2 and Keras, Packt Publications, Birmingham – Mumbai, 2020
3. Otmar Scherzer, Bernd Hofmann, Zuhair Nashed, Gauss Newton method for solving linear inverse problems with neural network coders, Sampling Theory, Signal Processing, and Data Analysis, 2023, 21:25, Birkhäuser. https://doi.org/10.1007/s43670-023-00066-6
4. https://en.wikipedia.org/wiki/Universal_approximation_theorem
5. https://www.geeksforgeeks.org/universal-approximation-theorem-for-neural-networks/
6. https://mitliagkas.github.io/

S. No.	Course Code	Subject name	Remarks
1	MS2103	Industrial Elective-I	Will be assigned by Industrial Expert/Academic Expert in consultation with Department/students
2	MS2104	Industrial Elective-II	Will be assigned by Industrial Expert/Academic Expert in consultation with Department/students

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CURRICULUM

Programme	M.Sc. Data Science			Academic Year of Regulation				2026-27	
Department	Basic and Applied Science			Semester				III	

Course Code	Course Name	Credit Structure				Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	

Course Code	Course Name	L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
MS2105	Quantitative Finance	3	0	0	3	20	30	50	100	

Course Objectives	1. To know the concepts of Mathematical Finance 2. To implement the concepts of Mathematical Finance using computer.	Course Outcomes	CO1	Will learn concepts of Mathematical finance	*Understanding/ Comprehension*
			CO2	Will learn how the concepts in Mathematical finance work in real time scenario	*Identify/ Knowledge/ Remember*
			CO3	Will get know how to convert the Mathematical framework to computational framework	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	**Basics about Stochastic Processes** Stochastic variables - Stochastic processes, martingale property - Stochastic integration, Itô integral	6	**CO1, CO2**
II	**Introduction to Financial Asset Dynamics** Geometric Brownian motion asset price process - First generalizations - Martingales and asset prices	8	**CO1, CO2, CO3**
III	**The Black-Scholes Option Pricing Equation** Option contract definitions - The Feynman-Kac theorem and the Black-Scholes model - Delta hedging under the Black-Scholes model	12	**CO1, CO2, CO3**
IV	**Local Volatility Models and Jump processes** Black-Scholes implied volatility - Option prices and densities - Non-parametric local volatility models - Jump diffusion processes - Feynman-Kac theorem for jump diffusion process	14	**CO1, CO2, CO3**
	Total Hours	40	

Text Books

1. Cornelis W Oosterlee, Lech A Grzelak, Mathematical Modeling Computation in Finance, World Scientific, ISBN 978-1-78634-794-7 ISBN 978-1-78634-805-0 (pbk), 2020

2. Avishek Nag, Stochastic Finance with Python, Design Financial Models from Probabilistic Perspective, Apress, 2024. ISBN-13 (pbk): 979-8-8688-1051-0 ISBN-13 (electronic): 979-8-8688-1052-7. https://doi.org/10.1007/979-8-8688-1052-7.

Reference Books

1. Steven Shreve: Stochastic Calculus and Finance, Springer, 1997

2. Steven Shreve, Stochastic calculus for Finance, Part I & II, Springer

3. Sankarshan Basu, John C. Hull, Options, futures and other derivatives, Pearson Education; 2022 & Series, Pearson Education

4. Paul Wilmott, Introduces Quantitative Finance, Second Edition, Wiley; 2nd edition (29 June 2007)

5. Siddhartha Pratim Chakrabarthy, Mathematical Finance: https://youtu.be/IrWeySxY9OA?list=PLwdnzlV3ogoV-4hbV6DP3BjdmjuaQPjcr

6. Siddhartha Pratim Chakrabarthy, Mathematical Portfolio Theory: https://youtu.be/EU1atD847oQ?list=PLwdnzlV3ogoVZdKHNNAoVbcFDVo0Wb0am

7. Anindya Goswami, https://www.youtube.com/playlist?list=PLEAYkSg4uSQ0Gmh0ozZ1nugWbuzSuuhqa

8. Brent Oksendal, Stochastic Differential Equations: An Introduction with Applications, Springer, 6th edition, 2004 & Series.

9. Eric Chin, Sverrir Ãlafsson, Dian Nel, Problems and Solutions in Mathematical Finance, Volume 1: Stochastic Calculus (The Wiley Finance Series), Wiley; 1st edition, 10 October 2014

10. Eric Chin, Sverrir Ãlafsson, Dian Nel, Problems and Solutions in Mathematical Finance Volume II - Equity Derivatives: 2 (The Wiley Finance Series) Hardcover – 3 February 2017

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation		2025-26
Department	Basic and Applied Science		Semester		I

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS2106	Generative Artificial Intelligence (AI)	3	0	0	3	20	30	50	100	

Course Objectives	1. To know the concepts of Generative Artificial Intelligence 2. To know the applications of Generative Artificial Intelligence	Course Outcomes	CO1	Will learn concepts of Generative AI	*Understanding/ Comprehension*
			CO2	Will learn how the Generative AI is applied practically	*Identify/ Knowledge/ Remember*
			CO3	Will get to know the connection between Mathematics and Generative AI	*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I	**Generative modeling** – What is Generative Modeling – First Generative Modeling – Probability theory – Generative Taxanomy	6	CO1, CO2
II	**Deep Learning** – Data for Deep Learning – Deep Neural Network – Multilayer Perceptron – Convolutional Neural Network	8	CO1, CO2, CO3
III	**Methods** – Variational Autoencoders – Autoencoders – Variational autoencoders – Exploring the Latent Space	10	CO1, CO2, CO3
IV	Generative Adversarial Networks – Deep Convolutional GAN – Autoregressive Models – Normalizing Flow Models – Energy Based Models – Diffusion Models	16	CO1, CO2, CO3
Total Hours		40	

Text Books

1. David Foster, Generative Deep Learning, Teaching Machines to Paint, Write, Compose, and Play, O'Reilly, 2023
2. Ian Goodfellow, Aaron Courville, Yoshua Bengio, Deep Learning, The MIT Press, 2016

Reference Books

1. Kevin Murphy, Probabilistic Machine Learning: An Introduction, The MIT Press, 2022
2. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006
3. Deepak Kanungo, Probabilistic Machine Learning for Finance and Investing A Primer to Generative AI with Python, O'Reilly, 2023
4. Ni Li, Yunqin Liu, Guanghong Gong, Luming Zhao, Haitao Yuan, A generative deep learning approach for real-time prediction of hypersonic vehicles in fluid-thermo-structural coupling fields, Aerospace Science and Technology 139 (2023) 108398. https://doi.org/10.1016/j.ast.2023.108398

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Programme	M.Sc. Data Science				Academic Year of Regulation			2026-27
Department	Basic and Applied Science				Semester			I

Course Code	Course Name	Credit Structure					Marks Distribution			
		L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
MS2201	Elective (Online or NPTEL or as faculty advisor)	3	0	0	3	20	30	50	100	

Course Objectives	**TO BE SELECTED FROM THE LIST GIVEN FOR ELECTIVES**	Course Outcomes	CO1		Understanding/ Comprehension
			CO2		Identify/ Knowledge/ Remember
			CO3		Understanding/ Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I		6	CO1, CO2
II		12	CO1, CO2, CO3
III		12	CO1, CO2, CO3
IV		10	CO1, CO2, CO3
Total Hours		40	

Text Books

Reference Books

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CURRICULUM

Programme	M.Sc. Data Science		Academic Year of Regulation	**2026-27**
Department	Basic and Applied Science		Semester	**I**

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
MS2202	PROJECT/INTERNSHIP	3	0	0	3	20	30	50	100	

Course Objectives	**TO BE DONE BY THE STUDENTS**	Course Outcomes	CO1		*Understanding/ Comprehension*
			CO2		*Identify/ Knowledge/ Remember*
			CO3		*Understanding/ Analyzing*

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	1												
2	CO2	3	2	1												
3	CO3	3	3	3	3	1										

SYLLABUS			
No.	Content	Hours	COs
I		6	CO1, CO2
II		12	CO1, CO2, CO3
III		12	CO1, CO2, CO3
IV		10	CO1, CO2, CO3
Total Hours		40	

Text Books

Reference Books

List of Electives
Elective Courses

S. No.	Topics	Credits
MS2201	Classical Fluid dynamics	3
MS2202	Measure Theory (Real & Functional)	3
MS2203	River modeling/Fluvial sedimentation modeling	3
MS2204	Statistical mechanics	3
MS2205	Climate modeling	3
MS2206	Portfolio theory and Risk Management	3
MS2207	Thin films	3
MS2208	Plasma Physics	3
MS2209	Particle Dynamics	3
MS2210	Statics	3
MS2211	Glaciers Modeling	3
MS2212	Hypersonic fluid flow	3
MS2213	Computational Chemistry	3
MS2214	Bayesian Neural Networks	3
MS2215	Gaussian Process	3
MS2216	Generative Models	3
MS2217	Energy based methods	3
MS2218	Diffusion models	3
MS2219	Reinforcement learning	3
MS2220	High Performance Computing	3
MS2221	Deep Learning for the Life Science	3
MS2222	Graph Theory	3
MS2223	Complex Network Analysis	3
MS2224	Course suggested by Instructor with students consent from NPTEL or other institute recognized MOOC's portal or Physical mode course.	3

Eligibility: B.Sc. (Physics/Mathematics/Computer Science/Data Science) & B. Tech. or equivalent