Programme Structure

Sharda School of Basic Sciences & Research

Department of Mathematics

M.Sc. (Data Science & Analytics)

Programme Code:SBR0309

Batch: 2023-25

Department of Mathematics
Sharda School of Basic Sciences and Research
M. Sc. (Data Science & Analytics) Batch: 2023-25
TERM: 2301 (Semester-I)

S. No.	COURSE CODE	Course Name	Teaching Load				CREDITS	PRE-REQUISITE/CO-REQUISITE	Type of Course: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY								
			L	**T**	**P**	**TOTAL**			
1.	MDA101	Foundations of Data Science	4	0	-	4	4		CC
2.	MMT104	Statistical Methods	4	0	-	4	4		CC
3.	MDA102	Mathematics for Machine Learning	4	0	-	4	4		CC
4.	MDA103	Probability Theory and Distributions	4	0	-	4	4		CC
5.	MDA104	Next Generation Databases	4	0	-	4	4		AECC
	PRACTICALS								
6.	MDA151	Practical -I (Based on Paper MMT104, MDA102UsingExcel/SPSS/Mini-tab)	-	-	4	4	2		AECC
7	MDA152	Practical -II (Based on Paper MMT104, MDA102,103,104UsingR/Python)	-	-	4	4	2		AECC
8	RBL001	Research Based Learning-1	0	0	4	0	0		Project
TOTAL							**24**		

CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Department of Mathematics
Sharda School of Basic Sciences and Research
M. Sc. (Data Science & Analytics) Batch: 2023-25
TERM: 2302 (Semester-II)

S. No.	COURSE CODE	Course Name	Teaching Load				CREDITS	PRE-REQUISITE/CO-REQUISITE	Type of Course: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY								
			L	**T**	**P**	**TOTAL**			
1.	MMT130	Numerical Analysis	4	0	0	4	4		CC
2.	MDA105	Regression Analysis and Predictive Models	4	0	0	4	4		CC
3.	MDA106	Statistical Data Preparation & Analytics	4	0	0	4	4		CC
4.	MDA107	Advanced Big Data and Text Analytics	4	0	0	4	4		CC
5.	MDA108	Data Mining & Artificial Intelligence	4	0	0	4	4		SEC
6.	CCU401	Community Connect	-	-	2	2	2		SEC
	PRACTICALS								
7.	MDA153	Practical-III (Based on Paper MDA105, 106, 107 Using R/Python/SAS/SPSS)	-	-	4	4	2		AECC
8.	MDA154	Practical-IV(Based on Paper MDA108 using R/Python)	-	-	4	4	2		AECC
9	RBL002	Research Based Learning-2	0	0	4	0	0		Project
TOTAL							**26**		

Department of Mathematics
Sharda School of Basic Sciences and Research
M. Sc. (Data Science & Analytics) Batch: 2023-25
TERM: 2401 (Semester-III)

S. No.	COURSE CODE	Course Name	Teaching Load				CREDITS	PRE-REQUISITE/CO-REQUISITE	Type of Course: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY								
			L	**T**	**P**	**TOTAL**			
1.	MDA201	Inferential Statistics	4	0	0	4	4		CC
2.	MDA202	Multivariate Data Analysis	4	0	0	4	4		CC
3.	MDA203	Soft Computing Techniques	4	0	0	4	4		AECC
4.	MDA204	Exploratory Data Analysis and Visualization	4	0	0	4	4		
5.	OPEXXX	Open elective (GE)	2	-	-	2	2		AECC
	PRACTICALS								
6.	MDA251	Practical -V (based on MDA201, MDA202) (using SPSS/SAS/STRATA)	-	-	4	4	2		AECC
7.	MDA252	Practical-VI (using based on MDA203, MDA204)	-	-	4	4	2		
TOTAL							**22**		

Department of Mathematics
Sharda School of Basic Sciences and Research
M. Sc. (Data Science & Analytics) Batch: 2023-25
TERM: 2402 (Semester-IV)

S. No.	COURSE CODE	Course Name	HOURS				CREDITS	PRE-REQUISITE/CO-REQUISITE	Type of Course: 1. CC 2. AECC 3. SEC 4. DSE
	THEORY								
			L	**T**	**P**	**TOTAL**			
1.	MDAXXX	Elective-I(Online/Offline Courses)	4	0	0	4	4		DSC
2.	MDAXXX	Elective-II(Online/Offline Courses)	4	0	0	4	4		DSC
	DISSERTATION								
3.	MDA253	Capstone project (Based on fulltime training program/internship program in any government/private institute or industry during last semester)	-	-	20	6weeks (min. 30days)	10		AECC
TOTAL							**18**		

COURSE MODULE

SYLLABUS

M.Sc. (Data Science &Analytics)

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**MDA101**	
2	Course Title	**Foundations of Data Science**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The course is aimed at building the fundamentals of data science. Imparting design thinking capability to build big data and developing design skills of models for big data problems. Gaining practical experience in programming tools for data sciences and also empowering students with tools and techniques used in data science.	
6	Course Outcomes	CO1: Explain data evolution and application on the data. (K1, K2) CO2: Discuss the basic concepts of data science. (K2, K3) CO3: Apply Matrix decomposition techniques to perform data analysis.(K3, K4) CO4: Explain the concept of a real-life solution. (K3, K4) CO5: Apply and develop basic Machine Learning Algorithms. (K5, K6) CO6: Apply the statistical measures of R in a real-time environment.(K5, K6)	
7	Course Description	A PG-level course in the foundation of data science intended to versestudents in the techniques necessary to understand and carry out methods in the foundation of data science.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction**	
	A	Introduction-What is Data Science?	CO1
	B	The steps in Doing Data Science-Skills needed to do DataScience storing data-combining bits into larger structures	CO1
	C	The steps in Doing Data Science-Skills needed to identify Data Problems.	CO1
	Unit 2	**EDA**	
	A	Big Data and Data Science - Big Data Analytics, Business intelligence vs big data, big data frameworks,	CO2
	B	Exploratory Data Analysis (EDA), statistical measures,	CO2
	C	Basic tools (plots, graphs, and summary statistics) of EDA, Data Analytics Lifecycle, Discovery	CO2
	Unit 3	**Data Pre-processing and Feature Selection**	
	A	Data cleaning - Data integration - Data Reduction - Data Transformation and Data Discretization.	CO3
	B	Feature Generation and Feature Selection, Feature Selection algorithms: Filters- Wrappers - Decision Trees -Random Forests	CO3
	C	Descriptive statistics-Using Histograms to understand a distribution-Normal Distribution.	CO3, CO6
	Unit 4	**Basic of R**	
	A	Getting Started with R-Installing R-Using R-Creating and Using Vectors-Follow the Data-Understanding existing.	CO4
	B	Data sources-Exploring Data Models-Rows and Columns-Creating Data Frames-Exploring.	CO4

	C	Importing Data Using R Studio-Accessing Excel data- Accessing Database-Comparing SQL and R for accessing a data set.			CO4, CO6
	Unit 5	**Basic Data Mining**			
	A	Data Mining Overview-Association Rule Mining-Text Mining-Supervised and Unsupervised Learning.			CO5
	B	Supervised Learning via Support Vector Machines- Support.			CO5
	C	Vector Machines in R-Creating Web Applications with R.			CO5, CO6
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Jeffrey S. Saltz, Jeffre M. Stanton, "AnIntroduction to Data Science", Sage Publications.			
	Other References	1. Nina Zumal, John Mount (2014). Practical Data science in R, Managing Publication Company 2. Bernard Kolman, Robert C. Busby and Sharon Ross (2004). Discrete Mathematical Structures, New Delhi: Prentice Hall 3. V. Bhuvaneswari, T. Devi, (2016). Big Data Analytics: A Practitioner's Approach, Bharathiar University 4. V. Bhuvaneswari (2016). Data Analytics with R, Bharathiar University.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA101.1	**3**	**-**	**3**	**3**	**-**	**3**	**3**	**2**	**1**
MDA101.2	**3**	**-**	**3**	**3**	**-**	**3**	**2**	**1**	**1**
MDA101.3	**2**	**-**	**2**	**3**	**-**	**2**	**2**	**1**	**1**
MDA101.4	**2**	**-**	**3**	**3**	**-**	**2**	**3**	**1**	**1**
MDA101.5	**3**	**-**	**3**	**3**	**-**	**3**	**2**	**2**	**2**
MDA101.6	**3**	**-**	**3**	**3**	**-**	**2**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	MDA102	
2	Course Title	Mathematics for Machine Learning	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To enable the students to understand the concept of mathematics inmachine learning.	
6	Course Outcomes	CO1: Solve a system of Linear equations by applying the Gauss Elimination method. (K2, K3) CO2: Explain the basics of Vectors, Spaces, and Affine Spaces. (K2, K3) CO3: Apply different methods to evaluate the Inverse and Rank of aMatrix. (K1, K2, K3) CO4: Evaluate Eigen values and Eigen vectors using Linear transformation and power methods. (K3, K4) CO5: Evaluate Derivatives and Partial Derivatives using rules ofdifferentiation. (K4, K5) CO6: Apply optimization using gradient function. (K5, K6)	
7	Course Description	The course focuses on iterative techniques for solving large sparse linear systems of equations which typically stem from the Discretization of partial differential equations. In addition, the computation of eigenvalues, least square problems and error analysis will be discussed.	
8			CO Mapping
	Unit 1	**Matrices and Determinants**	
	A	Matrices – Determinant, Identity matrix, Inverse of amatrix.	CO1
	B	The rank of a matrix, Nullity, trace of a matrix.	CO1
	C	Eigen values, Eigen vectors, Matrix decompositions.	CO1
	Unit 2	**Basic Concept of Linear Algebra**	
	A	Linear Algebra-System of Linear equations, SolvingSystem of Linear equations.	CO2
	B	Linear Independence, Vectors, Scalars, Addition, Scalar multiplication.	CO2
	C	Dot product, vector projection, cosine similarity	CO2
	Unit 3	**Vector**	
	A	Orthogonal vectors, normal and Orthonormal vectors.	CO3
	B	Vector norm, vector space, linear combination.	CO3
	C	Basis of vectors, Affine spaces.	CO3
	Unit 4	**Derivatives**	
	A	Differentiation, rules of differentiation, Derivatives, Scalar derivatives.	CO4
	B	Partial derivatives, Principle Component analysis – Concepts and properties.	CO4
	C	Dimensionality reduction with PCA	CO4
	Unit 5	**Derivatives of Function**	
	A	Differentiation of univariate functions, Partial differentiation and gradients.	CO5
	B	Gradient of a vector-valued function. Gradient of matrices.	CO5
	C	Optimization using gradient functions, Constrained optimization, and Lagrange multipliers. Convex optimization.	CO6
	Mode of examination	**Theory**	

	Weightage Distribution	CA	MTE	ETE	
		25 %	25 %	50 %	
	Text book/s*	1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning**", Cambridge University Press, 2020.**			
	Other References	1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition., John Wiley & Sons, (2014). 2. B. S.Grewal, Higher Engineering Mathematics, 38th Edition. Khanna Publications, (2005).			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA102.1	**3**	**-**	**2**	**3**	**-**	**3**	**3**	**2**	**1**
MDA102.2	**3**	**-**	**2**	**3**	**-**	**3**	**2**	**1**	**1**
MDA102.3	**3**	**-**	**2**	**3**	**-**	**2**	**2**	**1**	**1**
MDA102.4	**3**	**-**	**2**	**3**	**-**	**2**	**3**	**1**	**1**
MDA102.5	**3**	**-**	**2**	**3**	**-**	**3**	**2**	**2**	**2**
MDA102.6	**3**	**-**	**2**	**3**	**-**	**2**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**MDA103**	
2	Course Title	**Probability Theory and Distributions**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To incorporate the concepts of probability theory and its applications as the core material in building theoretical ideas along with real- lifedata.	
6	Course Outcomes	After completion of this course, students will be able to CO1: Develop problem-solving techniques needed to calculate probability and conditional probability. (K2, K3, K4) CO2: Formulate fundamental probability distribution and density functions, as well as functions of random variables, derive the probability density function of transformations. (K4, K5) CO3: Derive the expectation and conditional expectation, and describe their properties. (K4, K5) CO4: Discuss various types of generating functions used in statistics.(K3, K4) CO5:Apply sampling distributions to testing of hypotheses. (K4, K5) CO6: Illustrate and correlate the statistical problems into Statisticalanalysis. (K5, K6)	
7	Course Description	To integrate the intrinsic ideas of preliminary and advanced distributions to correlate with real-world scenarios.	
8			CO Mapping
	Unit 1	**Probability and Random variables**	
	A	Introduction to Random Experiments, Empirical basis of probability, Algebra of events, laws of probability; Conditional Probability, Independence, Bayes' law; Application of probability to business and economics.	CO1
	B	One-dimensional Random Variable-Discrete and Continuous; Distribution functions and their properties.	CO1
	C	Bivariate Random Variables- Joint Probability functions,marginal distributions, conditional distribution functions; The notion of Independence of Random variables.	CO1
	Unit 2	**Random Variables and Expectations**	
	A	Functions of random variables: introduction, distribution function technique, transformation technique: one variable, transformation technique: several variables, theory, and applications.	CO2
	B	Expectation, Variance, and Co-variance of random variables; Conditional expectation and conditional variance.	CO2
	C	Markov, Holder, Jensen, and Chebyshev's Inequality; Weak Law of Large numbers, Strong law of large numbers and Kolmogorov theorem; Central Limit Theorem.	CO2
	Unit 3	**Generating Functions and Discrete Distributions**	
	A	Probability generating function (p.g.f.), moment generating function (m.g.f.), characteristic function (c.f.).	CO3
	B	Properties and Applications. Probability distributions of functions of random variables: one and two dimensions.	CO3
	C	Bernoulli, Binomial, Poisson, Geometric, Hyper geometric, Negative Binomial, Multinomial, distributions and Discrete Uniform distribution - definition, properties and applications with numerical problems.	CO3, CO6

	Unit 4	**Continuous Distributions**			
	A	Uniform, Normal distribution function, Exponential distribution functions - definition, properties, and applications.			CO4
	B	Gamma, Beta distributions (First and Second kind), Weibull, Cauchy, and Laplace distribution functions-definition, properties, and applications.			CO4
	C	Lognormal, logistic, Pareto and Rayleigh distribution functions definition, properties and applications. Concept of truncated distributions.			CO4, CO6
	Unit 5	**Sampling Distributions**			
	A	Introduction, The sampling distribution of the Mean: Finite Populations, Sampling distribution of the proportion.			CO5
	B	t-distribution and F distribution, properties, applications, and procedure of hypothesis testing.			CO5
	C	Chi-square distribution and order statistics: properties, applications, and procedure of hypothesis testing.			CO5, CO6
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		25 %	25 %	50 %	
	Text book/s*	1. Sheldon Ross; A First Course in Probability,Pearson, 2014. 2. Parimal Mukhopadhyay; An Introduction to theTheory of Probability, World scientific, 2012. 3. Irwin Miller, Marylee's Miller, John E. Freund's;Mathematical Statistics, Pearson, 2017			
	Other References	1. FetsjeBijma, Marianne Jonker and Aad van der Vaart; Introduction to Mathematical Statistics, Amsterdam University Press, 2018. 2. Krishnamoorthy, K., Handbook of Statistical Distributions with Applications, Chapman & Hall/CRC, 2006. 3. Rohatgi, V.K. and Ebsanes Saleh, A.K. Md., An introduction to Probability and Statistics, 2nd Ed.,John Wiley & Sons, 2002. 4. Shanmugam, R., Chattamvelli, R. Statistics forscientists and engineers, John Wiley, 2015.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA103.1	**3**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**1**
MDA103.2	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**1**	**1**
MDA103.3	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**
MDA103.4	**3**	**2**	**2**	**3**	**-**	**2**	**3**	**1**	**1**
MDA103.5	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**2**	**1**
MDA103.6	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**MDA104**	
2	Course Title	**Next Generation Databases**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To explore the concepts of NoSQL Databases. To understand and use columnar and distributed database patterns.	
6	Course Outcomes	After completion of this course, students will be able to CO1: Develop and Explore the relationship between Big-Data andNoSQL databases. (K1, K2, K3) CO2: Formulate a fundamental relationship between Big-Data and NoSQL databases. (K2, K3) CO3: Describe various types of NoSQL databases to analyze the big data for useful business applications. (K3, K4) CO4: Derive and Work with NoSQL databases to analyze the big datafor useful business applications. (K4, K5) CO5: Discuss different data models to suit various data representations and storage needs. (K5, K6) CO6: Explain and correlate with different data models to suit various data representations and storage needs. (K5, K6)	
7	Course Description	To integrate the intrinsic ideas for the use of various Data models for a varietyof databases.	
8			**CO Mapping**
	Unit 1		
	A	Database Revolutions- system Architecture-Relational Database. Database Design-Data Storage-Transaction Management.	CO1
	B	Data warehouse and Data Mining-Information Retrieval. Big-Data Revolution-CAP Theorem.	CO1
	C	Birth of NoSQL-Document Database—XML Databases. JSON Document Databases-Graph Databases.Probability and Random variables	CO1
	Unit 2		
	A	Big-Data Revolution-CAP Theorem.	CO2
	B	Birth of NoSQL-Document Database—XML Databases.	CO2
	C	JSON Document Databases-Graph Databases.	CO2
	Unit 3		
	A	ColumnDatabases-Data Warehousing Schemes- Columnar Alternative-Sybase IQ-C-Store.	CO3
	B	Vertica-Column Database Architectures-SSD and In-Memory Databases.	CO3
	C	In-Memory Databases-Berkeley Analytics Data Stack and Spark.	CO3, CO6
	Unit 4		
	A	Distributed Database Patterns-Distributed Relational Databases-Non- relational Distributed Databases.	CO4
	B	MongoDB Sharing and Replication-HBase-Cassandra- Consistency Models.	CO4

	C	Types of Consistency-Consistency MongoDB - HBase Consistency-Cassandra Consistency.			CO4, CO6
	Unit 5				
	A	Data Models and Storage-SQL-NoSQLAP Is-Return SQL-Advance Databases-Postgre SQL.			CO5
	B	Riak-CouchDB-NEO4J-Redis-Future, Databases- Revolution Revisited-Counter revolutionaries-Oracle HQ.			CO5
	C	Other Convergent Databases-Disruptive Database Technologies.			CO5, CO6
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		25 %	25 %	50 %	
	Text book/s*	1. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill.			
	Other References	1. Guy Harrison, "Next Generation Databases",A Press, 2015. 2. Eric Redmond, Jim R Wilson, "Seven Databasesin Seven Weeks", LLC. 2012. 3. Dan Sullivan, "NoSQL for Mere Mortals",Addison-Wesley, 2015. 4. Adam Fowler, "NoSQL for Dummies", John			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA104.1	**2**	**1**	**3**	**2**	**-**	**3**	**3**	**2**	**1**
MDA104.2	**2**	**1**	**3**	**2**	**-**	**3**	**2**	**2**	**1**
MDA104.3	**2**	**1**	**3**	**2**	**-**	**2**	**2**	**2**	**1**
MDA104.4	**2**	**1**	**3**	**2**	**-**	**2**	**3**	**2**	**1**
MDA104.5	**2**	**1**	**3**	**2**	**-**	**3**	**2**	**2**	**2**
MDA104.6	**2**	**1**	**3**	**2**	**-**	**2**	**2**	**2**	**2**

School: SSBSR		**Batch: 2023-25**	
Programme: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**MDA151**	
2	Course Title	**Practical –I (Based on Paper MMT104, MDA102 Using Excel /SPSS /Minitab)**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	Introduce basic concepts of Excel/SPSS/Minitab environment and provide students with a general understanding of Excel/SPSS/Minitab for solving the statistical-based problem. Equip students with the skills to apply Excel/SPSS/Minitab concepts and analytical tools to analyze statistical problems and handle real-world issues.	
6	Course Outcomes	CO1: Describe the overall process and particular steps in designing studies, collecting, analyzing data, and interpreting and presentingresults. (K1, K2, K3) CO2: Develop skills in presenting quantitative data using appropriate diagrams, tabulations, and summaries. (K2, K4) CO3: Test for various hypotheses of significance like means, proportions, independence of attributes, variance, etc. included in the theory. (K3, K4) CO4: Discuss and illustrate various discrete and continuous probability distributions and study various real-life situations. (K4, K5) CO5: Identify the appropriate probability model that can be used. (K5, K6) CO6: Apply forecasting and data analysis techniques in the case of data sets. (K4, K5)	
7	Course Description	Introduce basic concepts of Excel/SPSS/Minitab environment and provide students with a general understanding of Excel/SPSS/Minitabfor solving the statistical-based problem. Equip students with the skills to apply Excel/SPSS/Minitab concepts and analytical tools to analyze statistical problems and handle real-world issues.	
8	Outline syllabus		CO Mapping
	Unit 1		
		Graphical representation of data by Histogram, Frequency polygons, frequency curves, and Ogives. Stem and Leaf Plot, Box Plot.	CO1
	Unit 2		
		Problems based on measures of central tendency. Problems based on measures of dispersion. Problems based on combined mean and variance and coefficient of variation. Problems based on moments, skewness, and kurtosis.	CO2
	Unit 3		
		Fitting of curves by the method of least squares. Determination of	CO3

		regression lines and calculation of correlation coefficient – grouped and ungrouped data. Calculation of multiple and partial correlation coefficients for three variables. Calculation of measures of association in contingency tables.			
	Unit 4				
		Fitting of Binomial, Poisson, and Normal distributions to observed data and testing of the goodness of fit.			CO4
	Unit 5				
		Analysis of variance in one-way and two-way classification (with and without interaction terms).			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		25 %	25 %	50 %	
	Text book				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA151.1	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**2**	**2**
MDA151.2	**1**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**2**
MDA151.3	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**
MDA151.4	**1**	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**2**
MDA151.5	**1**	**3**	**1**	**1**	**1**	**3**	**2**	**2**	**2**
MDA151.6	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**

School: SSBSR		Batch: 2023-25	
Programme: M.Sc.		Academic Year: 2023-24	
Branch: Data Science & Analytics		Semester: I	
1	Course Code	**MDA152**	
2	Course Title	**Practical –II (Based on Paper MMT104, MDA102, 103, 104UsingR/ Python)**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	Introduce basic concepts of R/ Python environment and provide students with a g students with the skills to apply R/ Python concepts and analytical tools to analy problem and handle real-world issues.	
6	Course Outcomes	CO1: Discuss and illustrate R/ Python environment. (K1,K2) CO2: Discuss and explain the importance of R/ Python workspace andworking d CO3: Discuss, calculate and understands the Statistics and plot and interpret the CO4: Discuss probability distribution and testing of hypothesis through R / Pyth CO5: Discuss and Explain creating matrices and some simple matrix operations, CO6: Develop a deeper understanding of the write R/ Python functions for Next	
7	Course Description	Introduce basic concepts of R/ Python environment and provide students with students with the skills to apply R/ Python concepts and analytical tools to an problem and handle real-world issues.	
8	Outline syllabus		CO Mapping
	Unit 1		
		Use of basic R/ Python software commands c( ), scan( ), rep( ), seq ( ), min, max, sort, extract, data. frame, matrix, accessing resident data sets etc.	CO1
	Unit 2		
		Finding summary statistics using summary () and five num(). Calculate the arithmetic mean (AM),geometric mean (GM), harmonic mean (HM), median,mode, quantiles, range, quartile deviation (QD), variance, coefficient of variation (CV) using R/Python.	CO2
	Unit 3		
		Computation of probabilities of negative binomial,multinomial, normal, exponential, gamma, , χ^2, using R/ Python.	CO3, CO6
	Unit 4		
		Creating matrices, some simple matrix operations,Sub-matrices also solve derivatives and some basic	CO4, CO6

		derivative function by using R/ Python.			
	Unit 5				
		File operations, Reading Next Generation Databases, Data Structures.			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		25 %	25 %	50 %	
	Text book				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA152.1	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**1**	**2**
MDA152.2	**1**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**2**
MDA152.3	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**
MDA152.4	**1**	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**2**
MDA152.5	**1**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**2**
MDA152.6	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Programme: M.Sc		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**RBL001**	
2	Course Title	**Research-Based Learning-1**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	1. Deep knowledge of a specific area of specialization. 2. Develop communication skills, especially in project writing and oral presentation. Develop some time management skills.	
6	Course Outcomes	CO1: Explain the concept of research within the subject, as regards approaching a question, collecting and analyzing background material, and presenting research questions and conclusions. (K2, K4) CO2: Construct and develop a deeper interest in mathematics and a taste for research. (K5, K6) CO3: Select and recommend activities that support their professional goals. (K4, K6) CO4: Develop effective project organizational skills. (K5) CO5: Analyse the problem and summarize research findings. (K4, K5) CO6: Use research findings to develop education theory and practice. (K3, K6)	
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.	
8	Outline syllabus		CO Achievement
	Unit 1	**Introduction**	**CO1**
	Unit 2	**Case study**	**CO1, CO2**

	Unit 3	**Conceptual**		**CO2, CO3**
	Unit 4	**Development**		**CO4, CO5**
	Unit 5	**Finalization**		**CO5, CO6**
	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	ETE	
	Text book/s*	-		
	Other References			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
RBL001.1	2	2	2	2	2	3	2	3	3
RBL001.2	2	2	2	2	3	2	3	3	2
RBL001.3	2	2	2	2	3	3	3	3	3
RBL001.4	2	2	2	2	2	3	2	3	2
RBL001.5	2	2	2	3	3	3	3	3	3
RBL001.6	2	2	2	3	3	3	3	3	3

School: SSBSR		**Batch: 2023-25**	
Programme: M.Sc.		**Academic Year: 2023-24**	
Branch: Mathematics		**Semester: II**	
1	Course Code	**MMT130**	
2	Course Title	**Numerical Analysis**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	• To provide the student with numerical methods of solving the non-linear equations, interpolation, differentiation, and integration. • To improve the student's skills in numerical methods by using the MATLAB	
6	Course Outcomes	CO1: Estimate errors in numerical solution of a given problem. CO2: Find a root of transcendental equation. CO3: Solve a linear system of equations using iterative and factorization methods and discuss its convergence. CO4: Estimate numerical value of differentiation and integration using interpolation. CO5: Solve initial value problems numerically through single-step and multi-step methods. CO6: Apply finite difference technique for the solution of ordinary and partial differential equations.	
7	Course Description	This course is an introduction to the numerical analysis. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems in MATLAB.	
8	Outline syllabus		CO Mapping
	Unit 1	**Error Analysis and solution of transcendental equations**	
	A	Definition and sources of errors, Propagation of errors, Sensitivity and conditioning, Stability and accuracy, Floating-point arithmetic and rounding errors.	CO1
	B	Intermediate value theorem, bisection method, method of false position, secant method, Newton Raphson method.	CO1, CO2
	C	Rate of convergence of iterative methods.	CO2
	Unit 2	**Solution of system of linear equations**	
	A	Iterative methods: Jacobi's method, Gauss-Seidal method	CO1, CO3
	B	Convergence criteria of iterative methods	CO3

	C	LU factorization methods: Crout, Choleski and Doolittle	CO3
	Unit 3	**Interpolation, differentiation and integration**	
	A	Finite difference operators, Newton Gregory forward and backward interpolation, Lagrange interpolation and Newton's divided difference interpolation	CO1, CO4
	B	Derivative formulae based on interpolating polynomial, Newton-Cotes quadrature formula	CO4
	C	Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Gauss quadrature formula.	CO1, CO4
	Unit 4	**Solution of ordinary differential equations**	
	A	Single-step methods: General definitions and Lipschitz condition, Derivations and stability analysis for Taylor series method	CO5
	B	Euler's method and its variants, Runge- Kutta second order and fourth order methods	CO1, CO5
	C	Solution of boundary value problems by finite difference technique.	CO1, CO6
	Unit 5	**Solution of Partial Differential Equations**	
	A	Finite difference approximations of partial derivatives	CO6
	B	Standard five-point and diagonal five-point formulae, solution of elliptic equations (Laplace and Poisson's equations) by Liebmann's iteration technique	CO1, CO6
	C	Solution of parabolic equation (one dimensional heat equation) by Bender-Schmidt and Crank Nicolson's methods, solution of hyperbolic equation (wave equation)	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		25% / 25% / 50%	
	Text book/s*	1) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd., Publishers, 6 ed, 2012. 2) S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt., Ltd., 5 ed, 2018. 3) C. F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Pearson Education, 2006.	
	Other References	1) E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications, 10 ed. 2) Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Education Pvt., Ltd., 5 ed, 2007.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MMT130.1	2	2	3	3	-	-	-	1	1
MMT130.2	2	2	3	3	-	-	-	1	1
MMT130.3	2	2	2	2	-	-	-	1	1
MMT130.4	2	2	2	2	-	-	-	1	1
MMT130.5	2	2	2	2	-	-	-	1	1
MMT130.6	2	2	2	2	-	-	-	1	1

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**MDA105**	
2	Course Title	**Regression Analytics and Predictive Models**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The main objective of this course is to demonstrate and intended to verse students in the techniques necessary to understand and carry out regression and predictive analysis.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Explain the concept of regression with two and multiple variables. CO2: Testing of the single and subset of the regression coefficient. CO3: Explain the concept of multicollinearity. CO4: Describe how to overcome the problem of heteroscedasticity and autocorrelation. CO5: Explain the concept of dummy variables. CO6: How to apply logistic regression on a dataset.	
7	Course Description	A PG-level course in regression analysis, intended to verse students in the techniques necessary to understand and carry out methods of research in serial analysis. Lectures study the large-sample properties of estimators based on one-sample, k-sample, and partial likelihood inference, with proofs based on the counting process and Martingale theory. The theory of competing risks is studied from several angles. Many extensions of the Cox model to more complex data structures are considered.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Simple Linear Regression: Simple linear regression model. Least-squares estimation of parameters. Hypothesis testing on the slope and intercept. Interval estimation in simple linear regression.	CO1
	B	Prediction of new observations. Coefficient of determination. Estimation by maximum likelihood.	CO1
	C	Multiple linear regression: Multiple linear regression models. Estimation of the model parameters. Hypothesis testing in multiple linear regression. Confidence intervals in multiple regression. Coefficient of determination and Adjusted R2.	CO1
	Unit 2		

	A	Logistic Regression: Introduction, Linear predictor and link functions, logit, probit, odds ratio, the test of hypothesis. Discriminant Analysis.			CO2
	B	Model Adequacy: Checking of linearity between study and explanatory variable, Residual Analysis, Detection and treatment of outliers, Residual plots.			CO2
	C	The PRESS statistic. Outlier test based on Studentized Residual (R-student). Test for lack of fit of the regression model.			CO2
	Unit 3				
	A	Data Understanding and Preparation Introduction, Reading data from various sources, Data visualization, Distributions, and summary statistics, Relationships among variables			CO3
	B	The extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation			CO3
	C	Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, and Missing Values.			CO3
	Unit 4				
	A	Model development & techniques Data Partitioning, Model selection, Model Development Techniques			CO4
	B	Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine			CO4
	C	Bayesian Networks, Linear Regression, Cox Regression, and Association rules.			CO4
	Unit 5				
	A	Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID			CO5
	B	Automating Models for Categorical and Continuous targets, Comparing and Combining Models, and Evaluation Charts for Model Comparison			CO5
	C	Meta Level Modeling, Deploying Model, Assessing Model Performance, Updating a Model.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Johnston, J. (1984). Econometric Methods, McGraw Hill Kogakusha Ltd.			
	Other References	1. Draper, N. R., and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third edition.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA105.1	3	2	3	3	-	2	2	1	1
MDA105.2	3	2	3	3	-	2	2	1	1
MDA105.3	3	2	2	2	-	2	2	1	1
MDA105.4	3	2	2	2	-	2	2	1	1
MDA105.5	3	2	2	2	-	2	2	1	1
MDA105.6	3	2	2	2	-	2	2	1	1

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**MDA106**	
2	Course Title	**Statistical Data Preparation & Analytics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The main objective of soft computing techniques is to improve data analysis solutions and strengthen the dialogue between the statistics and soft computing research communities. To cross-pollinate both fields and generate mutual improvement activities.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Learn about soft computing techniques and their applications. CO2: Analyse various neural network architectures. CO3: Understand perceptrons and counter propagation networks. CO4: Define the fuzzy systems. CO5: Analyse the genetic algorithms and their applications. CO6: Provide a body of concepts and techniques for designing intelligent systems.	
7	Course Description	A PG-level course in Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities.	
8	Outline syllabus		CO Mapping
	Unit 1	**Data Presentation**	
	A	Types of Data; Measurement Scale; Basic Statistics on Data, Overview of Big Data and Data Mining, Recognize trends in data and detect outliers; summarize data sets; Analyze relationships between variables.	CO1
	B	Create a representative sample; Conclude a larger population and Craft sound survey questions.	CO1
	C	Quantify the evidence in favor of or against your hypothesis, to make managerial decisions.	CO1
	Unit 2	**Data Visualization**	
	A	Organization/sources of data; Importance of data quality; Dealing with missing or incomplete data; Data Classification.	CO2
	B	Developing insight on Descriptive Analysis.	CO2

	C	Predictive Analysis, Prescriptive Analysis.			CO2
	Unit 3	**Statistical Modeling**			
	A	Time Series Modelling, Trend Analysis, Straight line, Moving averages, Naïve Forecasting, Delphi Technique			CO3
	B	Meaning of Decision Tree, Decision Tree Diagram, Decision tree Symbols, Drawing a decision tree, Advantages, and disadvantage			CO3
	C	Definition and Meaning of Decision Analysis (DA), Examples of Decision Analysis			CO3
	Unit 4	**Probability Distributions**			
	A	Probability Theory: Sample Spaces- Events - Axioms – Counting - Conditional Probability and Bayes' Theorem			CO4
	B	The Binomial Theorem – Random variable and distributions: Mean and Variance of a Random variable-Binomial-Poisson			CO4
	C	Normal distributions. Curve Fitting and Principles of Least Squares-Regression and correlation.			CO4
	Unit 5	**Sampling Distributions**			
	A	Sampling Distributions & Descriptive Statistics: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z).			CO5
	B	Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test, and Chi-Square test.			CO6
	C	Analysis of variance ANOVA – One-way and two-way classifications. MANOVA and MANCOVA			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2. S, Rajasekaran& G.A. VijayalakshmiPai, Neural Networks, 3. Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.			
	Other References	1.N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009. 3. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 4. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic, Theory & Applications, PHI Publication, 1st Edition, 2009. 5. Martin T Hagen, Neural Network Design, Nelson Candad, 2nd Edition, 2008.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA106.1	3	2	3	2	1	1	2	1	2
MDA106.2	3	2	3	2	1	1	2	1	2
MDA106.3	3	2	2	2	1	1	2	1	2
MDA106.4	3	2	2	2	1	1	2	1	2
MDA106.5	3	2	2	2	1	1	2	1	2
MDA106.6	3	2	2	2	1	1	2	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**MDA107**	
2	Course Title	**Advanced Big Data and Text Analytics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course aims to provide insight into the concepts of Natural Language Processing and its applications. This course helps the students to implement NLP applications using deep learning algorithms. This course helps to understand various word/text representation algorithms.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Learn about Big data techniques and their applications. CO2: Analyse various neural network problems. CO3: Use different word/text representation methods to see how words are related to each other. CO4: Model different NLP applications using Machine Learning/Deep learning algorithms CO5: Implement different deep learning models to solve real-time NLP problems CO6: Provide a body of concepts and techniques for designing intelligent systems.	
7	Course Description	A PG-level course in Soft Computing Techniques to Improve Big Data Analysis solutions is to strengthen the dialogue between the statistics and soft computing research communities.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Introduction to Big Data: Introduction to Big Data, Big Data characteristics	CO1
	B	Types of Big Data, Structured Data, Unstructured Data, and semi Structured Data.	CO1
	C	Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	CO1
	Unit 2		
	A	Mining Data Streams: The Stream Data Model: A Data Stream-Management System, Examples of Stream Sources, Stream Queries,	CO2

		Issues in Stream Processing.			
	B	Sampling Data in a Stream: Obtaining a Representative Sample, The General Sampling Problem, Varying the Sample Size. Filtering Streams: The Bloom Filter Analysis.			CO2
	C	Counting Distinct Elements in a Stream: The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements Counting Ones in a Window: The Cost of Exact Counts.			CO2
	Unit 3				
	A	The Big Data Analytics and Big Data Analytics Techniques: Big Data and its Importance, Drivers for Big data, Optimization techniques, Dimensionality Reduction techniques.			CO3
	B	Time series Forecasting, Social Media Mining, and Social Network Analysis, and its Application.			CO3
	C	Big Data analysis using Hadoop, Pig, Hive, MongoDB, Spark, and Mahout, Data analysis techniques like Discriminant Analysis and Cluster Analysis.			CO3
	Unit 4				
	A	Introduction to Natural Language Processing Words Regular Expressions N-grams Language modeling Part of Speech.			CO4
	B	Tagging Named Entity Recognition Syntactic and Semantic Parsing-Morphological Analysis			CO4
	C	Text Representation and Transformation-Vector space models Bag of Words Term Frequency Inverse Document Frequency Word Vector representations: Word2vec, GloVe, FastText, BERT-Topic Modelling			CO4
	Unit 5				
	A	Neural language models - Recurrent Neural Network - Long Short-Term Memory Networks			CO5
	B	Encoder decoder architecture - Attention Mechanism - Transformer networks			CO6
	C	Text classification-Sentiment Analysis-Neural Machine Translation - Question answering - Text summarization			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2.S, Rajasekaran& G.A. VijayalakshmiPai, Neural Networks, 3. Fuzzy Logic & Genetic Algorithms, Synthesis & applications,			

		PHI Publication, 1st Edition, 2009.	
	Other References	1.N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 3. Martin T Hagen, Neural Network Design, Nelson Candad, 2nd Edition, 2008.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA107.1	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**2**
MDA107.2	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**2**
MDA107.3	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**2**
MDA107.4	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**2**
MDA107.5	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**2**
MDA107.6	**3**	**2**	**2**	**3**	**1**	**1**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	MDA108	
2	Course Title	Data Mining & Artificial Intelligence	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To introduce students to the applications, concepts, and techniques of data mining. To provide a strong foundation of fundamental concepts in Artificial Intelligence.	
6	Course Outcomes	CO1: Learn about the data mining pattern and functionalities CO2: Understand the basic concepts and classification of Data mining CO3: Explain the mining of frequency pattern CO4: Explain the correlation and cluster analysis with applications. CO5: Learn about the basic concept of AI CO6:Explain computable functions, predicates, forward and backward reasoning	
7	Course Description	The data mining process includes data selection and cleaning, machine learning techniques to ``learn'' knowledge that is ``hidden'' in data, and the reporting and visualization of the resulting knowledge. AI helps the students to understand various searching techniques, constraint satisfaction problems, and example problems- game playing techniques.	
8	Outline syllabus		CO Mapping
	Unit 1	Data Mining	
	A	Introduction, Data, Types of Data, Data Mining Functionalities,	CO1,
	B	Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives,	CO1,
	C	Integration of a Data Mining System with Data Warehouse Issues, Data Preprocessing	CO1,
	Unit 2	Mining Frequent Pattern	
	A	Mining Frequent Patterns, Associations, and Correlations, Mining Methods, Mining various Kinds of Association Rules,	CO2
	B	Correlation Analysis, Constraint-Based Association Mining Classification, and Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification,	CO2

	C	Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, and Prediction.	CO3
	Unit 3	Cluster Analysis	
	A	Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-means, Partitioning Methods, Hierarchical Methods,	CO4
	B	Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High Dimensional Data, Constraint, Based Cluster Analysis, and Outlier Analysis.	CO4
	C	Data Mining Applications. Apply data mining techniques and methods to large data sets, Use data mining tools, and Compare and contrast the various classifiers.	CO4
	Unit 4	Basic of AI	
	A	Defining Artificial Intelligence, Defining AI techniques,	CO5
	B	Defining problems such as State Space search, Production systems, and characteristics,	CO5
	C	Hill Climbing, Breadth first and depth first search, Best first search.	CO5
	Unit 5	Mapping in AI	
	A	Representations and Mappings, Approaches to knowledge representation, Representing simple facts in logic,	CO6
	B	Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming,	CO6
	C	Forward vs backward reasoning, Non-monotonic Reasoning, Logic for non-monotonic reasoning.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		25% / 25% / 50%	
	Text book/s*	1. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008. 2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012. 3. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig	
	Other References	1. Artificial Intelligence, 2nd Edition, Rich and Knight. 2. . K.P. Soman, ShyamDiwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA108.1	3	2	3	1	-	1	2	1	2
MDA108.2	3	2	3	1	-	1	2	1	2
MDA108.3	3	2	2	1	-	1	2	1	2
MDA108.4	3	2	2	1	-	1	2	1	2
MDA108.5	3	2	2	1	-	1	2	1	2
MDA108.6	3	2	2	1	-	1	2	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**MDA 153**	
2	Course Title	Practical -III (based on MDA 105, MDA 106 MDA 107 using R/SPSS/SAS/Python)	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	After studying these courses students will be able to understand how to calculate the power of the test, analyze the multivariate data and understand the characteristics of multivariate quantitative research, including strengths and weaknesses. It also discusses the principles and characteristics of the multivariate data analysis techniques.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Estimate the parameter by MLE CO2: Learn about how to calculate the Rao, Lehman, and Bhattacharya bounds CO3: Learn how to calculate the critical region, power of the test, unbiased test, and Neyman structure. CO4: Understand the basic concepts of multivariate normal distribution. CO5: Calculate Wishart distribution in the multivariate analysis also know how to find Mahalanobis D2 and HottelingT2. CO6: Apply the classification rule, PCA, and factor analysis.	
7	Course Description	In this course, students are concerned with making inferences based on relations found in the sample, to relations in the population. Also multivariate analysis of data deals with examining the interrelationship between three or more equally important variables or explaining variation in, usually one (or more than one) dependent variable(s) based on two or more independent (explaining) variables.	
8	Outline syllabus		CO Mapping
	Unit 1	Multiple regression analysis	
		Problem-based on Multiple regression analysis SPSS/SAS/STRATA/R/Python.	CO1 CO2
	Unit 2	Logistic regression analysis	
		Problem-based on Logistic regression analysis SPSS/SAS/STRATA/R/Python.	CO2, CO3
	Unit 3	Discriminant Analysis	
		Problem-based on Discriminant Analysis using	CO3, CO4

		SPSS/SAS/STRATA/R/Python.			
	Unit 4	Principal Component Analysis			
		Problem-based on classification rule, PCA, and factor analysis using SPSS/SAS/STRATA/R/Python.			CO4,CO5
	Unit 5	Big Data Platform			
		Problem-based on Set up Hadoop Environment, Map Reduce Task using Hadoop			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		25%	25%	50%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA153.1	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA153.2	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA153.3	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA153.4	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA153.5	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA153.6	**1**	**1**	**3**	**3**	**-**	**1**	**2**	**1**	**2**

Practical-IV (MDA 154)

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**MDA 154**	
2	Course Title	Practical-IV (using based on MDA 108, using R/ Python)	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	The objective of the course is to introduce basic fundamental concepts in Artificial Intelligence (AI), with a practical approach to understanding them. To visualize the scope of AI and its role in futuristic development.	
6	Course Outcomes	After the completion of this course, students will be able to: CO1: Relate the goals of Artificial Intelligence and AI and non-AI solutions. CO2: Analyze various AI uninformed and informed search algorithms. CO3: Extend knowledge representation, reasoning, and theorem proving techniques to real-world problems CO4: Make use: Machine learning algorithms in various application domains of AI. CO5: Select Artificial Intelligent based applications. CO6: Develop independent (or in a small group) research and communicate it effectively.	
7	Course Description	In this course, students will learn a basic introduction to Artificial Intelligence, problem-solving agents, reasoning, learning, and applications of artificial intelligence.	
8	Outline syllabus		CO Mapping
	Unit 1	Practical based on Data Mining	CO1
	A	Association Rule: Apriori Algorithm	
	B	Correlation Analysis	
	C	Practice on Real time dataset (Kaggle, Open Data)	
	Unit 2	Practical based on Packages	CO2
	A	Basic of Numpy and Pandas	
	B	Basic of Scikit Learn	

	C	Basic of Tensorflow/Keras			
	Unit 3	Practical based on Classification and Clustering			CO3, CO6
	A	Classification: Decision Tree, Baye's Classifier, KNN			
	B	Clustering: K Mean, SVM			
	C	Hybrid: Random Forest			
	Unit 4	Practical based on Pre Processing and Model Selection			CO4, CO6
	A	Pre Processing: Creating Pipeline			
	B	Standarization and Normalization			
	C	Model Building, Selection and Model Accuracy			
	Unit 5	Practical based on Neural Network			CO5, CO6
	A	CNN			
	B	RNN			
	C	Boosting Algorithm: XGBoost, AdaBoost			
	Mode of examination	Practical/CE			
	Weightage Distribution	CA	CE	ETE	
		25%	25%	50%	
	Text book/s*	1. Rich E& Knight K, Artificial Intelligence, Tata McGraw Hill, Edition 3.			
	Other References	1. Russell S &Norvig P, *Artificial Intelligence: A Modern Approach*, Prentice Hall.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA154.1	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
MDA154.2	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
MDA154.3	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
MDA154.4	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
MDA154.5	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
MDA154.6	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Programme: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**RBL002**	
2	Course Title	**Research-Based Learning-2**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	1. Deep knowledge of a specific area of specialization. 2. Develop communication skills, especially in project writing and oral presentation. Develop some time management skills.	
6	Course Outcomes	CO1: Explain the concept of research within the subject, as regards approaching a question, collecting and analyzing background material, and presenting research questions and conclusions. (K2, K4) CO2: Construct and develop a deeper interest in mathematics and a taste for research. (K5, K6) CO3: Select and recommend activities that support their professional goals. (K4, K6) CO4: Develop effective project organizational skills. (K5) CO5: Analyse the problem and summarize research findings. (K4, K5) CO6: Use research findings to develop education theory and practice. (K3, K6)	
7	Course Description	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.	
8	Outline syllabus		CO Achievement
	Unit 1	**Introduction**	CO1
	Unit 2	**Case study**	CO1,CO2
	Unit 3	**Conceptual**	CO2,CO3

	Unit 4	**Development**		CO4,CO5
	Unit 5	**Finalisation**		CO5,CO6
	Mode of examination	Jury/Practical/Viva		
	Weightage Distribution	CA	ETE	
	Text book/s*	-		
	Other References			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
RBL002.1	2	2	2	2	2	3	2	3	3
RBL002.2	2	2	2	2	3	2	3	3	2
RBL002.3	2	2	2	2	3	3	3	3	3
RBL002.4	2	2	2	2	2	3	2	3	2
RBL002.5	2	2	2	3	3	3	3	3	3
RBL002.6	2	2	2	3	3	3	3	3	3

<table>
<tr><td colspan="2">SCHOOL:

School of Basic Sciences and Research</td><td>TEACHING DEPARTMENT:

Community Connect</td><td>Academic Year: 2023-24</td><td>FOR STUDENTS M.Sc.

Batch: 2023-25</td></tr>
<tr><td>1</td><td>Course Number</td><td colspan="3">Course Code: CCU401/ Course ID: 30804</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="3">Community Connect</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="3">2</td></tr>
<tr><td>3.01</td><td>(L-T-P)</td><td colspan="3">(0-0-2)</td></tr>
<tr><td>4</td><td>Learning Hours</td><td colspan="3"><table><tr><td>Contact Hours</td><td>30</td></tr><tr><td>Project/Field Work</td><td>20</td></tr><tr><td>Assessment</td><td>00</td></tr><tr><td>Guided Study</td><td>10</td></tr><tr><td>Total hours</td><td>60</td></tr></table></td></tr>
<tr><td>5</td><td>Course Objectives</td><td colspan="3">1. To expose our students to different social issues faced by people in different sections of society.

2. To connect their classroom learning with problem-solving skills in real-life scenarios.</td></tr>
<tr><td>6</td><td>Course Outcomes</td><td colspan="3">After completion of this course, students will be able to:

CO1. Recognize social problems prevailing in different sections of society and find the solution sustainably.

CO2. Get practical exposure to all-round development which complements their classroom learning

CO3. These activities will add value to students, faculty members, the school, and the university.

CO4. Apply their knowledge via research, and training for community benefit.

CO5. Analyze work on socio-economic projects with teamwork and timely delivery.

CO6. A survey will help to identify the gaps and create a plan to further improve the situation related to social problems prevailing in different sections of society and find the solution sustainably.</td></tr>
</table>

7	**Theme**	**Major research themes:** 1. ***Survey and self-learning***: In this mode, students will make a survey, analyze data, and will extract results to correlate with their theoretical knowledge. E.g. Crops and animals, land holding, labor problems, medical problems of animals and humans, savage and sanitation situations, waste management, etc. 2. ***Survey and solution providing***: In this mode, students will identify the common problems and will provide solutions/ educate the rural population. E.g. air and water pollution, need for treatment, use of renewable (mainly solar) energy, electricity saving devices, inefficiencies in the cropping systems, animal husbandry, poultry, pest control, irrigation, machining in agriculture, etc. 3. ***Survey and reporting***: In this mode, students will educate villagers and survey the ground-level status of various government schemes meant for rural development. The analyzed results will be reported to concerned agencies which will help them for taking necessary/corrective measures. E.g. Pradhan Mantri Jan Dhan Yojana, Pradhan Mantri MUDRA Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal pension Yojana, Pradhan Mantri Awas Yojana, Pradhan Mantri FasalBima Yojana, Swachh Bharat Abhiyan, Soil Health Card Scheme, Digital India, Skill India Programme, Beti Bachao, Beti Padhao Yojana, DeenDayal Upadhyaya Gram Jyoti Yojana, Shyama Prasad Mukherjee Rurban Mission, UJWAL Discom Assurance Yojana, PAHAL, Pradhan Mantri Awas Yojana-Gramin, Pradhan Mantri Yuva Yojana, Pradhan Mantri Jan Aushadhi Yojana, Pradhan Mantri KhanijKshetra Kalyan Yojana, Pradhan Mantri Suraksha Bima Yojana, UDAN scheme, DeenDayal Upadhyaya Grameen Kaushalya Yojana, Pradhan Mantri Sukanya Samriddhi Yojana, Sansad Adarsh Gram Yojana, Pradhan Mantri SurakshitMatritva Abhiyan, Pradhan Mantri RojgarProtsahan Yojana, Midday Meal Scheme, Pradhan Mantri Vaya Vandana Yojana, Pradhan Mantri Matritva Vandana Yojana, and Ayushman Bharat Yojana.
8.1	**Guidelines for Faculty Members**	It will be a group assignment. There should be no more than 10 students in each group. The faculty guide will guide the students and approve the project title and help the student in preparing the questionnaire and final report. The questionnaire should be well-designed and it should carry at least 20 questions (Including demographic questions). The faculty will guide the student to prepare the PPT. The topic of the research should be related to social, economical, or environmental issues concerning the common man. The report should contain 2,500 to 3,000 words and relevant charts, tables, and photographs. The student should **submit the report** to CCC-Coordinator signed by the faculty guide by 15 April 2019. The students have to send the hard copy of the **report and PPT**, and then only they

		will be allowed for ETE.
8.2	**Role of CCC-Coordinator**	The CCC Coordinator will supervise the whole process and assign students to faculty members. 1. PG-M.Sc.-Semester II – the students will be allocated to the faculty members (mentors/faculty members) in an even term. 2. UG- B.Sc.-Semester III - the students will be allocated to the faculty members (mentors/faculty members) in the odd terms.
8.3	**The layout of the Report**	Abstract (250 words) a. Introduction b. Literature review(optional) c. The objective of the research d. Research Methodology e. Finding and discussion f. Conclusion and recommendation g. References Note: The research report should base on primary data.
8.4	**Guideline for Report Writing**	**Title Page: The following elements must be included:** • Title of the article; • Name(s) and initial(s) of the author(s), preferably with first names spelled out; • Affiliation(s) of author(s); • Name of the faculty guide and Co-guide **Abstract:** Each article is to be preceded by a succinct abstract, of up to 250 words, that highlights the objectives, methods, results, and conclusions of the paper. **Text: Manuscripts should be submitted in Word.** • Use a normal, plain font (e.g., 12-point Times Roman) for text. • Use italics for emphasis. • *Use the automatic page numbering function to number the pages.* • *Save your file in Docx format* (Word 2007 or higher) or doc format (older Word versions) **Reference list:** The list of references should only include works that are cited in the text and that have been published or accepted for publication. The entries in the list should be in alphabetical order. Journal article Hamburger, C.: Quasimonotonicity, regularity, and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura Appl. 169, 321–354 (1995) Article by DOI Sajti, C.L., Georgio, S., Khodorkovsky, V., Marine, W.: New nanohybrid materials for biophotonics. Appl. Phys. A (2007). doi:10.1007/s00339-007-4137-z Book Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra. Kluwer, Boston (1992)

		Book chapter Broy, M.: Software engineering — from auxiliary to key technologies. In: Broy, M., Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, Heidelberg (2002) Online document Cartwright, J.: Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1 (2007). Accessed 26 June 2007 Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see www.issn.org/2-22661-LTWA-online.php For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list. EndNote style (zip, 2 kB) **Tables: All tables are to be numbered using Arabic numerals.** **Figure Numbering: All figures are to be numbered using Arabic numerals**. The soft copy of the final report should be submitted by email to Dr. PialiHaldar(piali.haldar@sharda.ac.in) by 16th **April 2019 along with a hard copy signed by the faculty guide.**
8.5	**Format:**	**The report should be Spiral/ hardbound** The Design of the Cover page to report will be given by the Coordinator- CCC Cover page Acknowledgment Content Project report Appendices

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CCU401.1	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CCU401.2	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CCU401.3	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CCU401.4	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CCU401.5	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**
CCU401.6	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**MDA201**	
2	Course Title	**Inferential Statistics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The course aims to understand the different properties of an estimator. After studying this course students will be able to understand the power of the test.	
6	Course Outcomes	CO1: Learn about the properties of the estimator. CO2: Understand the concept of the best estimator with examples CO3: Learn about the Rao, Lehman, and Bhattacharya bounds CO4: Understand the properties of MLE CO5: Learn the concept of the critical region and the power of the test CO6: Understand the unbiased test and Neyman structure	
7	Course Description	Inferential statistics are concerned with making inferences based on relations found in the sample, to relations in the population.	
8	Outline syllabus		CO Mapping
	Unit 1	**Properties of Estimator**	
	A	Point estimator, Interval estimator, Unbiasedness, Consistency, Efficiency, Sufficiency, Neyman Fisher lemma, Sufficient Statistics, and completeness,	CO1, CO2
	B	UMVUE, Cramer Rao Inequality along with the underlying conditions,	CO1, CO2
	C	Modification and extension of CR inequality.	CO1, CO2
	Unit 2	**Blackwellization**	
	A	Rao Blackwell theorem	CO3
	B	Lehman Scheffe theorem,	CO3
	C	Introduction to Bhattacharya bounds, consistency of an estimator.	CO3
	Unit 3	**MLE**	
	A	Maximum Likelihood estimation	CO4

	B	Properties of MLE			CO4
	C	BAN, Pitman estimator, and its efficiency.			CO4
	Unit 4	**Critical Region**			
	A	Best critical region, Generalized Neyman Pearson lemma,			CO5
	B	UMP tests for distribution with MLR			CO5
	C	LR test and their properties.			CO5
	Unit 5	**Neyman Structure**			
	A	Unbiased tests,			CO6
	B	Locally most powerful tests,			CO6
	C	Similar regions and tests of Neyman structure.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Mood, Graybill and Boes, An introduction to the theory of Statistics 3rd edition			
	Other References	1. Kendal & Stuart, The Advanced Theory of Statistics Vol II, Charles Griffin. 2. E. L. Lehman, Testing of Statistical Hypothesis, John Wiley & Wiley Eastern			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA201.1	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA201.2	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA201.3	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA201.4	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA201.5	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA201.6	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	MDA202	
2	Course Title	Multivariate Data Analysis	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The course aims to analyze multivariate data and understand the characteristics of multivariate quantitative research, including strengths and weaknesses. It also discusses the principles and characteristics of multivariate data analysis techniques.	
6	Course Outcomes	CO1: Learn about the multivariate data; Evolution and understanding of the data. CO2: Understand the basic concepts of multivariate normal distribution. CO3: Utilize the Wishart distribution in multivariate analysis. CO4: Mahalanobis D^2 and Hotelling T^2 CO5:Apply the classification rule in decision theory CO6: Utilization of PCA and factor analysis.	
7	Course Description	A large amount of data is collected on many different variables across disciplines to understand the underlying process(es). The multivariate analysis of data deals with examining the interrelationship between three or more equally important variables or explaining variation in usually one (or more than one) dependent variable(s) based on two or more independent (explaining) variables.	
8	Outline syllabus		CO Mapping
	Unit 1	**Multivariate Normal Distribution**	
	A	Multivariate Normal Distribution	CO1, CO2
	B	Probability density function and other properties	CO1, CO2
	C	Marginal and condition distribution.	CO1, CO2
	Unit 2	**Wishart**	
	A	Wishart distribution	CO3
	B	Probability density and distribution function,	CO3
	C	Characteristic function and its properties.	CO3
	Unit 3	**Data Pre-processing and Feature Selection**	
	A	Hotelling T^2, Mahalanobis D^2,	CO4

	B	Properties and functional forms of T^2 and D^2			CO4
	C	Represent their relationship and application.			CO4
	Unit 4	**Basic of R**			
	A	Classification analysis,			CO5
	B	discrimination analysis,			CO5
	C	Bayesian classification and decision design.			CO5
	Unit 5	**Basic Data Mining**			
	A	Principal Component Analysis,			CO6
	B	Canonical Correlation and variables,			CO6
	C	Factor Analysis,			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. T.W. Anderson, Multivariate Analysis, John Wiley & Wiley Eastern.			
	Other References	2. Johnson & Wichem, Applied Multivariate Analysis, Wiley & Wiley Eastern.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA202.1	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA202.2	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA202.3	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA202.4	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA202.5	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**
MDA202.6	**1**	**-**	**3**	**3**	**-**	**1**	**2**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	MDA203	
2	Course Title	Soft Computing Techniques	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities to cross-pollinate both fields and generate mutual improvement activities.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Learn about soft computing techniques and their applications. CO2: Analyse various neural network architectures. CO3: Understand perceptrons and counter-propagation networks. CO4: Define the fuzzy systems. CO5: Analyse the genetic algorithms and their applications. CO6: Provide a body of concepts and techniques for designing intelligent systems.	
7	Course Description	A PG-level course in Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities.	
8	Outline syllabus		CO Mapping
	Unit 1	Soft Computing & AI	
	A	Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing.	CO1
	B	Introduction, Various types of production systems, characteristics of production systems, breadth-first search, depth-first search techniques, other Search Techniques like hill Climbing, Best-first Search, A* algorithm, AO* Algorithms, and various types of control strategies.	CO1
	C	Knowledge representation issues,Prepositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.	CO1
	Unit 2	Neural Network	

	A	Structure and Function of a single neuron.			CO2
	B	Biological neuron, artificial neuron, the definition of ANN, Taxonomy of the neural net, Difference b/w ANN and the human brain.			CO2
	C	Characteristics and applications of AssNN, single layer network.			CO2
	Unit 3	Perceptron & Counter propagation network			
	A	Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN.			CO3
	B	Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.			CO3
	C	Architecture, functioning & characteristics of counter Propagation network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations, and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation, and training. Associative Memory.			CO3
	Unit 4	Fuzzy Logic & Fuzzy rule base system			
	A	Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations.			CO4
	B	Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.			CO4
	C	Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.			CO4
	Unit 5	Genetic algorithm			
	A	Fundamental, basic concepts, working principle, encoding, fitness function, and reproduction.			CO5
	B	Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA.			CO6
	C	Applications & advances in GA, Differences & similarities between GA & other traditional methods.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI			

		Publication, 1st Edition, 2009.	
	Other References	1. N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009. 3. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 4. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic, Theory & Applications, PHI Publication, 1st Edition, 2009. 5. Martin T Hagen, Neural Network Design, Nelson Candid, 2nd Edition, 2008.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA203.1	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**
MDA203.2	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**
MDA203.3	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**
MDA203.4	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**
MDA203.5	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**
MDA203.6	**1**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	MDA204	
2	Course Title	Exploratory Data Analysis and Visualization	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The main objective of the course is to introduce the methods for data preparation and data understanding. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Handle missing data in real-world data sets by choosing appropriate methods. CO2: Summarize the data using basic statistics. Visualize the data using basic graphs and plots. CO3: Identify the outliers if any in the data set. CO4: Choose appropriate feature selection and dimensionality reduction. CO5: Techniques for handling multi-dimensional data. CO6: Having problem-solving ability- solving social issues and problems related to data science.	
7	Course Description	A PG-level course in Exploratory Data Analysis and Visualization to support and summarize the insurer's use of predictive analytics, data science, and Data Visualization.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction To Exploratory Data Analysis	
	A	Data Analytics lifecycle, Exploratory Data Analysis (EDA).	CO1
	B	Definition, Motivation, Steps in data exploration.	CO1
	C	The basic data types Data Type Portability.	CO1
	Unit 2	Pre-processing-Traditional Methods, MLE and Bayesian Estimation	
	A	Introduction to Missing data, Traditional methods for dealing with missing data.	CO2
	B	Maximum Likelihood Estimation: Basics, Missing data handling, Improving the accuracy of the analysis.	CO2
	C	Introduction to Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis, and Pooling Phase, Practical Issues in	CO2

		Multiple Imputations, Models for Missing Notation Random Data.	
	Unit 3	Data Summarization & Visualization	
	A	Statistical data elaboration, 1-D Statistical data analysis.	CO3
	B	Statistical data elaboration, 2-D Statistical data analysis.	CO3
	C	Statistical data elaboration, N-D Statistical data analysis.	CO3
	Unit 4	Outlier Analysis & Feature Subset Selection	
	A	Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density Based outlier analysis, Outlier Detection in Categorical Data.	CO4
	B	Feature selection algorithms: filter methods, wrapper methods, embedded methods, Forward selection backward elimination.	CO4
	C	Relief, greedy selection, genetic algorithms for features election.	CO4
	Unit 5	Dimensionality Reduction & Contemporary issues	
	A	Introduction, Principal Component Analysis (PCA), Kernel PCA.	CO5
	B	Canonical Correlation Analysis, Factor Analysis, Multi-dimensional scaling, Correspondence Analysis.	CO6
	C	Recent Trends Problems.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		25% / 25% / 50%	
	Text book/s*	1. Charu C. Aggarwal, "Data Mining The Textbook", Springer, 2015.	
	Other References	1. Craig K. Enders, "Applied Missing Data Analysis", The Guilford Press, 2010. 2. Inge Koch, "Analysis of Multivariate and High dimensional data", Cambridge University Press, 2014. 3. Michael Jambu, "Exploratory and multivariate data analysis", Academic Press Inc., 1990. 4. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2015	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA204.1	1	1	3	3	-	1	1	1	2
MDA204.2	1	1	3	3	-	1	1	1	2
MDA204.3	1	1	3	3	-	1	1	1	2
MDA204.4	1	1	3	3	-	1	1	1	2
MDA204.5	1	1	3	3	-	1	1	1	2
MDA204.6	1	1	3	3	-	1	1	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**MDA 251**	
2	Course Title	**Practical-V (based on MDA 201, and MDA 202 using R/SPSS/SAS/STRATA/Python)**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	After studying this course students will be able to understand how to calculate the power of the test, analyze the multivariate data and understand the characteristics of multivariate quantitative research, including strengths and weaknesses. It also discusses the principles and characteristics of multivariate data analysis techniques.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Estimate the parameter by MLE CO2: Learn about how to calculate the Rao, Lehman, and Bhattacharya bounds CO3: Learn how to calculate the critical region, power of the test, unbiased test, and Neyman structure. CO4: Understand the basic concepts of multivariate normal distribution. CO5: Calculate Wishart distribution in the multivariate analysis also know how to find Mahalanobis D^2 and HottelingT^2. CO6: Apply the classification rule, PCA, and factor analysis.	
7	Course Description	In this course, students are concerned with making inferences based on relations found in the sample, to relations in the population. Also multivariate analysis of data deals with examining the interrelationship between three or more equally important variables or explaining variation in, usually one (or more than one) dependent variable(s) based on two or more independent (explaining) variables.	
8	Outline syllabus		CO Mapping
	Unit 1		
		Problem-based on the estimation of the parameter, Rao, Lehman, and Bhattacharya bounds using SPSS/SAS/STRATA/R/Python.	CO1, CO2
	Unit 2		
		Problem-based on critical region, power of the test, unbiased test, and Neyman structure using SPSS/SAS/STRATA/R/Python.	CO2, CO3
	Unit 3		
		Problem-based on multivariate normal distribution using	CO3, CO4

		SPSS/SAS/STRATA/R/Python.			
	Unit 4				
		Problem-based on Wishart distribution, Mahalanobis D2, and HottelingT2using SPSS/SAS/STRATA/R/Python.			CO4, CO5
	Unit 5				
		Problem-based on classification rule, PCA, and factor analysis using SPSS/SAS/STRATA/R/Python.			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		25%	25%	50%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA251.1	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
MDA251.2	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
MDA251.3	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
MDA251.4	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
MDA251.5	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
MDA251.6	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**MDA 252**	
2	Course Title	Practical -VI (using based on MDA 203, and MDA 204 using R/ Python)	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to analyze solutions to strengthen the dialogue between the statistics and soft computing research communities to cross-pollinate both fields and generate mutual improvement activities. It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.	
6	Course Outcomes	At the end of the course, the student should be able to CO1: Learn about soft computing techniques and their applications, and analyze various neural network architectures. CO2: Understand perceptrons and counter propagation networks, Define the fuzzy systems. CO3: Analyze the genetic algorithms and their applications. CO4: Handle missing data in real-world data sets by choosing appropriate methods. CO5: Summarize the data using basic statistics. Visualize the data using basic graphs and plots. Identify the outliers if any in the data set. CO6: Choose appropriate feature selection and dimensionality reduction. Techniques for handling multi-dimensional data.	
7	Course Description	Using R/ Python try to solve the problem related to Soft Computing Techniques. Exploratory Data Analysis, Visualization, summarizes the insurer's use of predictive analytics, identifies the outliers, dimensionality reduction, and Data Visualization for multi-dimensional data.	
8	Outline syllabus		CO Mapping
	Unit 1		
		Create a perceptron with the appropriate no. of inputs and outputs. Train it using a fixed increment learning algorithm until no change in weights is required. Output the final weights. Create a simple ADALINE network with an appropriate no. of input and output nodes. Train it using the delta learning rule until no change in weights is required. Output the final weights.	CO1

	Unit 2		
		Train the autocorrelator by given patterns: A1=(-1,1,-1,1), A2=(1,1,1,-1), A3=(-1, -1, -1, 1). Test it using patterns: Ax=(-1,1,-1,1), Ay=(1,1,1,1), Az=(-1,-1,-1,-1). Train the hetrocorrelator using multiple training encoding strategies for given patterns: A1=(000111001) B1=(010000111), A2=(111001110) B2=(100000001), A3=(110110101) B3(101001010). Test it using pattern A2.	CO1, CO2
	Unit 3		
		Implement Union, Intersection, Complement, and Difference operations on fuzzy sets. Also, create fuzzy relation by the Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations. Solve Greg Viot's fuzzy cruise controller using Python Fuzzy logic toolbox. Solve Air Conditioner Controller using Python Fuzzy logic toolbox. Implement TSP using GA.	CO2, CO3
	Unit 4		
		Problem-based on Data Summarization, Visualization, Outlier Analysis, and Feature Subset Selection using R/python.	CO4,CO5
	Unit 5		
		Problem-based on PCA, Canonical Correlation Analysis, Factor Analysis, Multi-dimensional scaling, and Correspondence Analysis using R/python.	CO5, CO6
	Mode of examination	Practical	
	Weightage Distribution	CA / CE / ETE	
		25% / 25% / 50%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA252.1	1	3	1	1	-	1	1	1	2
MDA252.2	1	3	1	1	-	1	1	1	2
MDA252.3	1	3	1	1	-	1	1	1	2
MDA252.4	1	3	1	1	-	1	1	1	2
MDA252.5	1	3	1	1	-	1	1	1	2
MDA252.6	1	3	1	1	-	1	1	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA212**	
2	Course Title	**Statistical Analysis-Count Data and Survival Analysis**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	To demonstrate and intended to verse students in the techniques necessary to understand and carry out methods of research in survival analysis.	
6	Course Outcomes	CO1: Explain the concept of survival data, the roles played by censoring, and survival and hazard functions. CO2: Format data appropriately for analysis, and understanding. CO3: Apply and drew the graph of survival data, and the Kaplan – Meier curve. CO4: Explain the concept of Kernel smoothed distribution estimator and kernel smoothed hazard rate estimator. CO5: Describe how to fit the Cox Proportional Hazards model. CO6: Apply models to the data analysis using the Cox proportional hazards model.	
7	Course Description	A PG-level course in survival analysis, intended to verse students in the techniques necessary to understand and carry out methods of research in survival analysis. Lectures study the large-sample properties of estimators based on one-sample, k-sample, and partial likelihood inference, with proofs based on the counting process and Martingale theory. The theory of competing risks is studied from several angles. Many extensions of the Cox model to more complex data structures are considered.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Basic quantities. The survival functions. The hazard functions. The mean residual lifetime function and median life.	CO1
	B	Common parametric models for survival data. Models for competing risks.	CO1
	C	Right censoring. Left or interval censoring. Truncation. Likelihood construction for censored and truncated data. Basic ideas for counting processes and martingales.	CO1
	Unit 2		
	A	Nonparametric estimators of the survival and cumulative hazard	CO2

		functions. Kaplan-Meier estimator and Nelson-Allen estimator.	
	B	Point-wise confidence intervals for the survival and cumulative hazard functions.	CO2
	C	Confidence bands for the survival function. Point and interval estimates of the mean and median survival time, and quintiles.	CO2
	Unit 3		
	A	Estimators of the survival function for left-truncated and right-censored data. Summary curves for competing risks.	CO3
	B	Estimating the survival function for left, double, and interval censoring.	CO3
	C	Estimation of the survival functions for right-truncated data. Estimation in the cohort life table or grouped data.	CO3
	Unit 4		
	A	Kernel smoothed distribution estimator and kernel smoothed hazard rate estimator.	CO4
	B	Hypothesis testing. One-sample tests. Tests for two samples and more than two samples. Tests for trend. Stratified log-rank test.	CO4
	C	Parametric models with covariates. The accelerated failure time (AFT) model. Some popular AFT models. Diagnostic methods for parametric models.	CO4
	Unit 5		
	A	The Cox proportional hazards model. Partial likelihoods for distinct-event time data.	CO5
	B	Partial likelihood when ties are present. Local tests. Estimation of the survival function.	CO6
	C	Additional materials: Model building and high-dimensional data analysis using the Cox proportional hazards model.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE 25% / 25% / 50%	
	Text book/s*	1. Lee, E. T., and Wang, J. W. (2003). Statistical Methods for Survival Data Analysis, 3rd Edition. John Wiley. 2. Liu, X. (2012). Survival Analysis: Models and Applications, Wiley, New York.	
	Other References	1. Kleinbaum, D. G. andKlein, M. (2012). Survival Analysis: A Self-Learning Text, 3rdEd, Springer, New York. 2. Hosmer, D. and Lemeshow, S. (1999). Applied Survival Analysis: Regression Modeling of Time to Event Data, Wiley, New York.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA212.1	3	-	1	1	-	1	1	1	3
MDA212.2	3	-	1	1	-	1	1	1	3
MDA212.3	3	-	1	1	-	1	1	1	3
MDA212.4	3	-	1	1	-	1	1	1	3
MDA212.5	3	-	1	1	-	1	1	1	3
MDA212.6	3	-	1	1	-	1	1	1	3

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA213**	
2	Course Title	**Industrial Statistics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	To make students familiar with the concept of statistics and display data using various tables, charts, and graphs and also introduce basic statistical concepts of measures of central tendency and dispersion, correlation, regression, and their applications.	
6	Course Outcomes	CO1: Describe the process of planning a statistical investigation and discuss different methods for data collection. (K2) CO2: Develop skills in presenting quantitative data using appropriate diagrams, tabulations, and summaries. (K2) CO3: Calculate the measures of central tendency and dispersion of data and describe the method used for analysis. (K2, K3) CO4: Calculate and interpret the correlation between two variables. (K3, K4) CO5: Find the line of best fit as a tool for summarizing a linear relationship and predicting future observed values. (K4, K5) CO6: Develop the skills to interpret the results of Industrial data. (K4, K5)	
7	Course Description	This is an introductory course in statistics. This course covers the fundamental concepts of measures of central tendency and dispersion, correlation, regression, and their applications.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Methods of classification, tabulation, diagrammatic & graphical representation of grouped data.	CO1
	B	Frequency distributions, cumulative frequency distributions, charts, and graphs.	CO1
	C	Line and bar diagram, histogram, frequency polygon, frequency curve.	CO1
	Unit 2		

	A	Measures of central tendency-use limitation and calculations of various averages, arithmetic mean, geometric mean, harmonic mean, median, mode, and partition.			CO2
	B	Measures of dispersion-use limitation and calculations of range, quartile deviation, mean deviation, standard deviation, and coefficient of variation.			CO2
	C	Moments and its applications and limitations, calculations of various measures of skewness and kurtosis.			CO2
	Unit 3				
	A	Simple correlation, scatter diagram, method of computing correlation, Karl Pearson and Rank correlation			CO3
	B	Simple linear regression, Principles of least squares using excel, regression lines.			CO3
	C	Fitting of polynomial curves and fitting of curves reducible to polynomial form.			CO3
	Unit 4				
	A	Process and product control, general theory of control charts, different types of control charts for variables and attributes,			CO4
	B	X, R, s, p, np, and c charts, cumulative sum chart, V-mask, single, double, multiple and sequential sampling plans for attributes, OC, ASN, AOQ, and ATI curves,			CO4
	C	concepts of producer's and consumer's risks, AQL, LTPD, and AOQL, sampling plans for variables, use of DodgeRomig and Military Standard tables.			CO4
	Unit 5				
	A	Concepts of reliability, maintainability, and availability, reliability of series and parallel systems and other simple configurations, renewal density, and renewal function,			CO5
	B	survival models (exponential), Weibull, lognormal, Rayleigh, and bath-tub), different types of redundancy and use of redundancy in reliability improvement,			CO6
	C	Problems in life-testing, censored and truncated experiments for exponential models			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Gupta,S.C. and Kapoor,V. K. "Fundamental of Mathematical Statistics". 2. Arora, P.N., Arora, S., Arora, S., Arora, Amit, "Comprehensive Statistical Methods".			

	Other References	1.Daniel, Wayne W., Industrial Statistics": Basic concept and Methodology for Industrial Statistics.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA213.1	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA213.2	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA213.3	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA213.4	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA213.5	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA213.6	**3**	**-**	**3**	**3**	**-**	**1**	**1**	**1**	**3**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	MDA214	
2	Course Title	Statistical Simulation	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	To demonstrate and intended to verse students in the techniques necessary to understand and carry out methods of research in Statistical simulation.	
6	Course Outcomes	CO1: Explain the concept of statistical simulation. (K1, K2, K3). CO2: How to generate random numbers by the different methods (K1, K2, K4) CO3: Explain the concept of the MCMC technique. (K3, K4, K5). CO4: Recognize the concepts of probability and statistics that are relevant to modeling and simulation. (K3, K4, K5). CO5: Design and implement Bootstrapping; jackknife resampling. (K3, K4, K5). CO6: How simulation may be used to understand the behavior of real-world systems by utilizing mathematical models with an emphasis on simulation (K3, K4, K5).	
7	Course Description	A PG-level course in Statistics, intended to verse students in the techniques necessary to understand and carry out methods of research in Statistical simulation. Lectures study the various applications of the MCMC technique.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Review of R/Python. Random number generation	CO1
	B	Inverse-transform; acceptance-rejection; transformations.	CO1, CO2
	C	Statistic simulations: generating random variables, and simulating normal, gamma, and beta random variables.	CO1, CO2
	Unit 2		
	A	Simulating multivariate distributions, MCMC methods.	CO3
	B	Gibbs sampler, simulating random fields, Simulating stochastic process.	CO3
	C	Variance reduction technique, importance sampling for integration, Control variate, and antithetic variables.	CO3
	Unit 3		
	A	Bootstrapping; jackknife resampling. Bootstrapping for estimation of the sampling distribution.	CO5

	B	Confidence intervals, variance stabilizing transformation.			CO5
	C	Bootstrapping in regression and sampling from finite populations.			CO5
	Unit 4				
	A	Simulating a non-homogeneous Poisson process.			CO4
	B	Optimization using Monte Carlo methods simulated annealing for optimization			CO4
	C	Solving differential equations by Monte Carlo methods			CO4
	Unit 5				
	A	Univariate density estimation, kernel smoothing multivariate density estimation			CO3, CO6
	B	Root finding: Numerical integration, numerical maximization/minimization, constrained and unconstrained optimization.			CO3, CO6
	C	EM algorithm, Simplex algorithm			CO3, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Fishman, G.S. (1996). Monte Carlo: Concept, algorithm, and application. (Springer)			
	Other References	Rubinstien R.V. (1981). Simulation and Monte Carlo method. Reply, B. D. (1987). Stochastic Simulation. (Wiley).			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MDA214.1	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA214.2	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA214.3	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA214.4	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA214.5	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**
MDA214.6	**3**	**1**	**3**	**3**	**-**	**1**	**1**	**1**	**3**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	MDA215	
2	Course Title	Advances in Design and Experiment	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	To introduce the basic principles and methods of statistical design of experiments. The significances of effects of various factors on a given response are determined under uncertainty using statistical principles.	
6	Course Outcomes	After the completion of this course, the student will be able to CO1: Build knowledge of basic principles of design of the experiment. CO2: Make use of the concept of various simple types of experimental designs. CO3: Make use of the concept of complex types of experimental designs. CO4: Evaluate the factorial experiment, confounding, and split/strip plot design. CO5: Apply the concept of missing-plot techniques, CO6: Apply cross-over design and transformation of data and response equation.	
7	Course Description	To introduce the basic principles and methods of statistical design of experiments. The significances of effects of various factors on a given response are determined under uncertainty using statistical principles.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Analysis of variance., Analysis of Covariance	CO1
	B	Basic principles of design of experiments	CO1
	C	Uniformity trials.	CO1
	Unit 2		
	A	Completely randomized design (CRD),	CO2
	B	Randomized complete block design (RCBD),	CO2
	C	Latin square design (LSD),	CO2
	Unit 3		
	A	Balanced incomplete block (BIB) design,	CO3

	B	Resolvable block designs and their applications:			CO3
	C	Randomization procedure, analysis, and interpretation of results.			CO3
	Unit 4				
	A	Factorial experiments (symmetrical as well as asymmetrical).			CO4
	B	Confounding in factorial experiments-application in 2n and 3n factorial experiments. Factorial experiments with extra treatment(s).			CO4
	C	Split plot and Strip plot designs.			CO4
	Unit 5				
	A	Groups of experiments.			CO5
	B	Missing plot technique and its application to RCBD,			CO6
	C	LSD, Cross-over design, Sampling in field experiments.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Cochran, W.G. and Coxx, G.M.1957. Experimental Designs. John Wiley and Sons. 2. Das, M.N. and Giri, N.C.1986. Design and Analysis of Experiments. New Age International.			
	Other References	1. Gomez, K.A. and Gomez, A.A.1984.Statistical Procedures for Agricultural Research. John Wiley & Sons. 2. Panse, V.G. and Sukhatme, P.V.1967.Statistical Methods for Agricultural Workers. ICAR Publication. 3. Steel, R.G.D.and Torrie, J.H.1960. Principles and Procedures of Statistics. McGraw Hill.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA215.1	3	-	3	3	-	1	1	1	2
MDA215.2	3	-	3	3	-	1	1	1	2
MDA215.3	3	-	3	3	-	1	1	1	2
MDA215.4	3	-	3	3	-	1	1	1	2
MDA215.5	3	-	3	3	-	1	1	1	2
MDA215.6	3	-	3	3	-	1	1	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA216**	
2	Course Title	**Statistics in Agriculture**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	This basic course is meant for students who do not have a sufficient background in statistical methods. The students would be exposed to concepts of statistical methods that would help them in understanding the importance and need for statistics. It would also help them in understanding the concepts involved in data presentation, analysis, and interpretation. The students would get exposure to the presentation of data, probability distributions, correlation and regression, tests of significance, and multivariate analytical techniques. The students would also be exposed to the basic design of experiments and sample surveys.	
6	Course Outcomes	After the completion of this course, the student will be able to CO1: Discover knowledge of descriptive statistics and probability theory. CO2: Examine the concept of probability distribution and test of significance CO3: Conclude the various aspects of correlation and regression. CO4: Develop the validation of models, confidence interval, and testing for heterogeneity. CO5: Compile concept of multivariate analytical tools. CO6: Application of statistical tools for analysis of agriculture data.	
7	Course Description		
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Classification, tabulation, and graphical representation of data.	CO1
	B	Descriptive statistics. Theory of probability. Random variable and mathematical expectation.	CO1
	C	Box-plot, Stem & leaf plot.	CO1
	Unit 2		
	A	Probability distributions: Binomial, Poisson, Negative Binomial, Normal distributions and their applications.	CO2
	B	Concept of sampling distribution: t, $\chi 2$, and F-distributions.	CO2
	C	Tests of significance based on normal, t, $\chi 2$, and F-distributions.	CO2

	Unit 3				
	A	Theory of estimation and confidence intervals. Correlation and regression. Simple and multiple linear regression models.			CO3
	B	Estimation of parameters. Predicted values and residuals. Correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation.			CO3
	C	Test of significance of correlation coefficient. Coefficient of determination. Polynomial regression models and their fitting.			CO3
	Unit 4				
	A	Selection of variables. Validation of models.			CO4
	B	Probit regression analysis by least squares and maximum likelihood methods.			CO4
	C	Confidence interval for sensitivity. Testing for heterogeneity.			CO4
	Unit 5				
	A	Introduction to multivariate analytical tools:			CO5
	B	Dimension reduction techniques, Principal Component Analysis, and Factor Analysis by using agriculture data.			CO6
	C	Cluster Analysis and Discriminant function analysis by using agriculture data.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Goon, A.M., Gupta, M.K. and Dasgupta, B.1977.An Outline of Statistical Theory.Vol. I. The World Press Pvt. Ltd. 2. Gomez, K.A. and Gomez, A.A.1984. Statistical Procedures for Agricultural Research. John Wiley.			
	Other References	1. Gupta, S.C. and Kapoor, V.K.2007. Fundamentals of Mathematical Statistics. Sultan Chand and Sons. 2. Panse, V.G.and Sukhatme, P.V.1967. Statistical Methods for Agricultural Workers. ICAR Publication.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA216.1	3	-	3	3	1	1	1	1	1
MDA216.2	3	-	3	3	1	1	1	1	1
MDA216.3	3	-	3	3	1	1	1	1	1
MDA216.4	3	-	3	3	1	1	1	1	1
MDA216.5	3	-	3	3	1	1	1	1	1
MDA216.6	3	-	3	3	1	1	1	1	1

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA222**	
2	Course Title	**Applied Econometrics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	The objective of this course is to introduce regression analysis to students so that they can understand its applications in different fields of economics.	
6	Course Outcomes	CO1: Able to have a concise knowledge of basic regression analysis of economic data and interpret and critically evaluate outcomes of empirical analysis. (K1, K2, K3). CO2: Analyse the theoretical background for standard methods used in empirical analyses, like properties of least squares estimators and statistical testing of hypotheses. (K2, K3, K4). CO3: Able to apply for modern computer programs in regression analyses of empirical data, including statistical testing to investigate whether the classical assumptions in regression analysis are satisfied. (K2, K3, K4). CO4: Design and development of a real-life model based on econometric methods. (K4, K5, K6). CO5: Develop and apply advanced methods for the implementation of econometric techniques also various functions for economic analysis and future forecasting. (K5, K6). CO6: Able to use econometric models in their future work. (K4, K5).	
7	Course Description	The purpose of this course is to give students a solid foundation in econometric techniques, various functions for economic analysis, and future forecasting. Many of the methods introduced in this course are also useful in business, finance, and many other disciplines.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Introduction to econometrics. A review of least squares and maximum likelihood estimation methods of parameters in the classical linear regression model and their properties.	CO1
	B	Generalized least squares estimation and prediction, construction of confidence regions.	CO1
	C	Tests of hypotheses, use of dummy variables, and seasonal adjustment.	CO1

	Unit 2		
	A	Regression analysis under linear restrictions, restricted least squares estimation method, and its properties.	CO2
	B	The problem of Multicollinearity, its implications, and tools for handling the problem.	CO2
	C	Ridge regression. Heteroscedasticity, consequences, and tests for it.	CO2
	Unit 3		
	A	Estimation procedures under heteroscedastic disturbances, Bartlett's test, Breusch Pagan test, and GoldfelfQuandt test.	CO3
	B	Autocorrelation, sources, and consequences.	CO3
	C	Autoregressive process tests for autocorrelation.	CO3
	Unit 4		
	A	Durbin Watson test. Asymptotic theory and regressors.	CO4
	B	Instrumental variable estimation, errors in variables.	CO4
	C	Simultaneous equations model, the problem of identification, a necessary and sufficient condition for the identifiability of parameters in a structural equation.	CO4
	Unit 5		
	A	Ordinary least squares, indirect least squares.	CO5
	B	Two-stage least square.	CO6
	C	Limited information maximum likelihood method.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA | MTE | ETE	
		25% | 25% | 50%	
	Text book/s*	1. Gujarati, D.N. & Porter, D.C. (2017). Basic Econometrics, 6th Edition.McGraw Hill. 2. Maddala, G.S. &Lahiri, K. (2010). Introduction to Econometrics, 4th Edition.Wiley.	
	Other References	1. Greene, W.H. (2012). Econometric Analysis, 7th Edition. Pearson. 2. Studenmund, A.H. &Johnson, B.K. (2017). Using Econometrics: A Practical Guide, 7th Edition. Pearson.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA222.1	3	1	3	3	1	1	1	1	2
MDA222.2	3	1	3	3	1	1	1	1	2
MDA222.3	3	1	3	3	1	1	1	1	2
MDA222.4	3	1	3	3	1	1	1	1	2
MDA222.5	3	1	3	3	1	1	1	1	2
MDA222.6	3	1	3	3	1	1	1	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA224**	
2	Course Title	**Digital Marketing**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	The Digital Marketing Course aims to provide students with the knowledge about business advantages of digital marketing and its importance for marketing success.	
6	Course Outcomes	CO1: Students will be able to identify the importance of digital marketing for marketing success (K2, K3). CO2: To manage customer relationships across all digital channels and build better customer relationships (K2, K3). CO3: To create a digital marketing plan, starting from the SWOT analysis and defining a target group (K3, K4). CO4: Describe and identify digital channels for their advantages and limitations (K3, K4). CO5: Describe how to do business with the different digital platforms and also cost optimization through this platform (K2, K3, K4). CO6: Illustrate how to make a sample Business model of digital marketing on different platforms. (K3, K6)	
7	Course Description	This course provides students with knowledge about the business advantages of digital marketing and its importance for marketing success; develop a digital marketing plan; make a SWOT analysis; define a target group; to get introduced to various digital channels, their advantages, and ways of integration; to get basic knowledge of Google Analytics for measuring effects of digital marketing and getting an insight of future trends that will affect the future development of the digital marketing.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Introduction of digital marketing, Digital vs. Real Marketing, and Digital Marketing Channels.	CO1
	B	Creating an initial digital marketing plan, content management, SWOT analysis, and target group analysis.	CO1
	C	Web design, Optimization of Web sites, MS Expression Web.	CO1

	Unit 2				
	A	SEO Optimization, Writing the SEO content.			CO2
	B	Google Ad Words- creating accounts, Google Ad Words- types.			CO2
	C	Introduction to CRM, CRM platform, and CRM models.			CO2
	Unit 3				
	A	Introduction to Web analytics, Web analytics – levels, Introduction of Social Media Marketing.			CO3
	B	Creating a Facebook page, Visual identity of a Facebook page, and Types of publications.			CO3
	C	Business opportunities and Instagram options, Optimization of Instagram profiles, Integrating Instagram with a Web Site and other social networks and Keeping up with posts.			CO3
	Unit 4				
	A	Business tools on LinkedIn, Creating campaigns on LinkedIn, Analysing visitation on LinkedIn			CO4
	B	Creating business accounts on YouTube, YouTube Advertising, YouTube Analytics,			CO4
	C	Facebook Ads, Creating Facebook Ads, Ads Visibility.			CO4
	Unit 5				
	A	E-mail marketing, E-mail marketing plan, E-mail marketing campaign analysis, Keeping up with conversions.			CO5
	B	Digital Marketing Budgeting- resource planning- cost estimating- cost budgeting- cost control.			CO6
	C	Recapitulation: lessons learned- student satisfaction survey- closing.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. Digital Marketer.Pulizzi, J.(2014) Epic Content Marketing, Mcgraw Hill Education.			
	Other References	1. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited. 2. The Beginner's Guide to Digital Marketing (2015).			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA224.1	3	1	3	-	1	1	1	1	2
MDA224.2	3	1	3	-	1	1	1	1	2
MDA224.3	3	1	3	-	1	1	1	1	2
MDA224.4	3	1	3	-	1	1	1	1	2
MDA224.5	3	1	3	-	1	1	1	1	2
MDA224.6	3	1	3	-	1	1	1	1	2

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA220**	
2	Course Title	**IOT**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Elective	
5	Course Objective	The objective of this course is to enable students to understand the scope of the Internet of things in Industry and students will get to understand the working of different techniques, protocols, and algorithms which are commonly used in IoT applications.	
6	Course Outcomes	CO1: Able to understand the concept of the Internet of things. (K1, K2, K3). CO2: Analyse various IoT devices and their technology. (K2, K3, K4). CO3: Know about the selection and use of appropriate IoT technologies & gateway protocols for application development. (K1, K2, K3) CO4: Design and development of IoT applications with the use of different cloud technology. (K3, K4, K5) CO5: develop and apply the advanced methods for the implementation of the Internet of Things. (K5, K6). CO6: Enable students to understand the scope of the Internet of things in Industry. (K4, K6)	
7	Course Description	This course aims to give a basic understanding of the Internet of Things (IoT). Students will get to understand the working of different techniques, protocols, and algorithms that are commonly used in IoT applications. During the course, students will also get exposed to the various architecture for developing IoT applications such as OSI reference models, etc.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions.	CO1
	B	IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust.	CO1
	C	Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	CO1
	Unit 2		

	A	M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.	CO2
	B	A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The internationally driven global value chain, and global information monopolies.	CO2
	C	M2M to IoT-An Architectural Overview– Building an architecture, Main design principles, needed capabilities, An IoT architecture outline, and standards considerations.	CO2
	Unit 3		
	A	IoT Architecture-State of the Art –Introduction, State of the art.	CO3
	B	Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model.	CO3
	C	IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	CO3
	Unit 4		
	A	IoT Applications for Value Creations, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master.	CO4
	B	IoT Value Creation from Big Data and Serialization, IoT for Retailing Industry.	CO4
	C	IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	CO4
	Unit 5		
	A	Overview of Governance, Privacy, and Security Issues.	CO5
	B	Contribution from FP7 Projects, Security, Privacy, and Trust in IoT-Data-Platforms for Smart Cities.	CO6
	C	First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE 25% / 25% / 50%	
	Text book/s*	1. Samuel Greengard, The Internet of Things" by Samuel Greengard. 2. CunoPfister Author: CunoPfister, Getting started with the Internet of Things.	
	Other	1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.	

	References	2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA220.1	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA220.2	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA220.3	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA220.4	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA220.5	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA220.6	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**

School: SSBSR		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**MDA253**	
2	Course Title	**Capstone Project**	
3	Credits	10	
4	Contact Hours (L-T-P)	0-0-20	
	Course Status	Compulsory	
5	Course Objective	The course should be taught and implemented to develop the required course outcomes so that students will acquire the following competency needed by the industry: Plan innovative/creative solutions independently and/or collaboratively to integrate various competencies acquired during the semesters to solve/complete the identified problems/task/shortcomings faced by industry/user related to the concerned occupation.	
6	Course Outcomes	CO1: Plan a scientific project proposal with time duration (K2, K3). CO2: Select, collect, and use required information/knowledge to solve the problem/complete the task (K3, K4). CO3: Logically choose relevant possible solutions (K3, K4). CO4: Consider the ethical issues related to the project (if there are any) (K4, K5). CO5: Assess the impact of the project on society (if there is any) (K4, K5). CO6: Compile the entire project work to prepare a 'project report' with future scope. (K5, K6).	
7	Course Description	The course aims to give exposure to research in a real scenario to students. It caters to the needs of research designs, research methods, and various methodologies used. The course will further explain how to apply various data analysis tools to draw workable inferences for numerous problems and this course sharpens the student's analytical and decision-making skills.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Feasibility studies, Design projects,	CO1
	B	Market surveys	CO1
	C	Prototype (design, make, test, and evaluate)	CO1
	Unit 2	.	

	A	Advanced work requires the development of existing work to be used and developed.	CO2
	B	Field works: This could include surveys	CO2
	C	Charting data and information from visual observation.	CO2
	Unit 3		
	A	Comparative Studies: Theoretical study of systems/mechanisms/ processes in detail and comparing them based on cost/energy conservation/impact on environment/technology used etc.	CO3
	B	Application of Emerging science/technology: Theoretical study of some emerging concepts,	CO3
	C	Feasibility of its application in some real-life situations in detail.	CO3
	Unit 4		
	A	Collection/combination of some concepts etc.	CO4
	B	Construction of some structure/concepts	CO4
	C	Development of software or use of software for solving some broad-based problem.	CO4
	Unit 5		
	A	Plan for a report must have the following contents: introduction, review of literature, and research gaps of the study.	CO5
	B	Significance of the study, research methodology: objectives of the study, hypotheses of the study.	CO6
	C	Data analysis and interpretation, findings and conclusion, recommendations and limitations, Bibliography Annexure-Questionnaire/Schedules if any.	CO6
	Mode of examination		
	Weightage Distribution	CA: 25% / CE: 25% / ETE: 50%	
	Text book/s*	**1.** Rubin, Allen & Babbie, Earl (2009). Essential Research Methods for Social Work, Cengage Learning Inc., USA.	

	Other References	**2.** Neuman, W.L. (2008). Social research methods: Qualitative and quantitative approaches, Pearson Education. **3.** Pawar, B.S. (2009). Theory building for hypothesis specification in organizational studies, Response Books, New Delhi.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA253.1	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA253.2	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA253.3	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA253.4	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA253.5	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**
MDA253.6	**3**	**-**	**3**	**-**	**1**	**1**	**1**	**1**	**2**