Programme Structure

Department of Mathematics & Data Science

Sharda School of Engineering & Science

B.Sc. (Hons. / Hons. With Research) Data Science & Analytics

SBR0308

Batch 2025-29

Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

M1. Transformative educational experience.
M2. Enrichment by educational initiatives that encourage global outlook.
M3. Develop research, support disruptive innovations and accelerateentrepreneurship.
M4. Seeking beyond boundaries.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

Vision and Mission of School

Vision of the School

To apply basic and engineering sciences to solve global challenges of evolving society.

Mission of the School

1. Impart basic, advanced and transformative knowledge and skills in science and technology.
2. To Build capacity and capabilities in cutting-edge technology and research.
3. To Nurture research and entrepreneurship temperament to develop solutions for global, societal and environmental problems.
4. To Foster and strengthen multi-dimensional partnerships and collaborations.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

Vision and Mission of Department of Mathematics & Data Science

Vision of the Department

To become a globally recognized destination for education in mathematical science and research.

Mission of the Department

1. To develop mathematical skills in students and make them employable across a wide range of professions and promote interest in research.
2. To develop entrepreneurial skills in students by encouraging critical thinking, innovation, and interdisciplinary applications of mathematics, data science and statistics.
3. To develop skills for the applications of mathematics, statistics and data science in the various fields.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

B. Sc. (Hons. /Hons. With Research) Data Science & Analytics

Programme Educational Objectives (PEOs)

PEO1: Prepare professionals conversant with current and advanced technological tools to carry out Investigation, analysis and synthesis by identifying various compute-oriented solutions.

PEO2: To develop positive attitude and skills which enable them to become a multi facet personality.

PEO3: To prepare students in such a way so that they perform excellently in national label entrance examinations conducted by various well-known institution like IIT's/ central Universities/other academic institutes etc. to pursue their PG/MS/Dual PG and Ph.D. programs.

PEO4: To make them aware of effective machine learning and Artificial Intelligence based data analytics and inference required for Industrial Application.

PEO5: To inculcate passion for lifelong learning by introducing principles of group dynamics, public policies, environmental and societal context.

Programme Outcomes (POs)

PO1. Complex Problem Solving: Solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

PO2. Critical Thinking: Analyze and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.

PO3. Creativity: Demonstrate the ability to think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by applying concepts of multidisciplinary and interdisciplinary.

PO4. Analytical reasoning/thinking: Evaluate the reliability and relevance of evidence.

PO5. Research-related skills: Demonstrate the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.

PO6. Communication Skills: Demonstrate the skills that enable them to express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.

PO7. Coordinating/collaborating with others: Demonstrate the ability to work effectively and respectfully with diverse teams using management skills to guide people to the right destination.

PO8. Digital and technological skills: Demonstrate the capability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data.

PO9. Value Inculcation: Instill integrity and identify ethical issues related to work, and follow ethical practices with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

PO10. Sustainability Growth: Demonstrate the capability to lead a diverse team or individual to accomplish and participate in community-engaged services/ activities for promoting the well-being of society to mitigating the effects of environmental degradation, climate change, and pollution.

PO11. Multidisciplinary Life-long learning: Comprehensive knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study in a broad multidisciplinary context by inculcating a healthy attitude to be a lifelong learner.

Programme Specific Outcomes of B.Sc. (Hons. /Hons. With Research) Data Science & Analytics

PSO1. Demonstrate proficiency with **statistical data analysis** by using advanced application tools.

PSO2. Apply data science concepts and methods to **solve** problems in real-world contexts.

PSO3. Estimate predictions for a given complex problem using data analytical methods not limited to machine learning and deep learning concepts.

Mapping of PEOs with Mission Statements

PEO Statements	School Mission1	School Mission2	School Mission3	School Mission4	School Mission5	School Mission6
PEO1	3	2	3	1	2	3
PEO2	3	2	3	1	2	3
PEO3	3	3	3	3	3	3
PEO4	3	2	3	1	3	3
PEO5	3	2	2	3	2	3

Mapping of Programme Outcomes Vs Programme Educational Objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	3	2	1
PO2	3	3	3	2	1
PO3	3	3	3	2	1
PO4	3	2	3	2	1
PO5	2	3	2	3	2
PO6	3	3	3	2	2
PO7	1	2	1	3	1
PO8	2	2	1	3	2
PO9	2	2	2	3	2
PO10	2	2	2	3	3
PO11	2	3	3	2	1
PSO1	2	1	1	2	1
PSO2	2	2	2	2	1
PSO3	3	3	3	2	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytics, Batch: 2025-29
Term: 2501 (Semester-I)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL**			
1.	MSM101	Foundation Course in Mathematics	4	0	0	4	4	Basic Mathematics upto 10+2	CC Major
2.	**DAT1101**	Foundation of Data Science	3	0	0	3	3		CC Major
3.	CMS102	Descriptive Statistics	3	0	0	3	3	Basic Mathematics upto 10+2	(Minor)
4.	**MTT1101**	Programming for Problem Solving	2	0	0	2	2		Multi Dis (DSE)
5.	**EVT1129**	Environmental Education	2	0	0	2	2		VAC
	PRACTICALS								
6.	**DAP1151**	Foundation of Data Science Lab	0	0	2	2	1		CC Major
7.	ARP101	Communicative English-1	1	0	2	3	2		AEC
8.	VOM103	Essential Excel Skills for Business	0	0	6	6	3		SEC
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytics, Batch: 2025-29
TERM: 2502 (Semester-II)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	CMS131	Matrix Analysis and Linear Algebra	4	0	0	4	4	Pre-requisite MSM101	CC
2.	**MTT1202**	Principal of Data Structures	3	0	0	3	3		CC
3.	CMS132	Mathematical Expectations & Probability Distributions	3	0	0	3	3		Minor
4.	VAC110	Yoga for Holistic Health	2	0	0	2	2		VAC
5.	VAC120(mulyapravaha)	Understanding India	2	0	0	2	2		VAC
	PRACTICALS								
6.	**MTP1251**	Principles of Data Structures Lab	0	0	2	2	1		CC
7.	ARP102	Communicative English-2	1	0	2	3	2		AEC
8.	VOM104	Advanced Excel Skills for Business	0	0	6	6	3	Pre-requisite VOM103	SEC
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytics, Batch: 2025-29
TERM: 2601 (Semester-III)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA217	Data Preparation and Data Cleaning	3	0	0	3	3		CC Major
2.	BDA313	Regression, Time Series, Forecasting and Index Numbers	5	0	0	5	5		CC Major
3.	BDA215	Operation Research	3	0	0	3	3		Minor
4.	XXX	Indian Language	2	0	0	2	2		AEC
	PRACTICALS								
5.	**DAP2351**	Data Preparation and Data Cleaning lab	0	0	4	4	2		CC Major
6.	**AI3407**	Prompt Engineering for AI and Data Science	0	0	4	4	2		DSE(Multi/Inter-discipli)
7.	**VOM2305**	Data Visualization with Tableau and Power BI	0	0	6	6	3		SEC
8.	**DAR2351**	Research Based Learning-I(RBL-1)	0	0	2	2	0		Research Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons./Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2602 (Semester-IV)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA202	Database Management Systems	4	0	0	4	4		CC
2.	BDA214	Sampling Theory	4	0	0	4	4		CC
3.	BDA323	Multivariate Data Analysis	4	0	0	4	4		CC
	Practicals								
4.	**DAP2452**	Sampling Lab	0	0	4	4	2(was 1)		CC
5.	AI3408	Supervised & Unsupervised Learning Techniques	0	0	6	6	3		Minor
6.	CCU108	Community Connect	0	0	2	2	2		AEC
7.	**DAR2452**	Research Based Learning-2(RBL-2)	0	0	2	2	1		Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2701 (Semester-V)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA303	Machine Learning	4	0	0	4	4		CC
2.	BDA322	Statistical Simulation	4	0	0	4	4		CC
3.	BDA318	Data Visualization	4	0	0	4	4		CC
4.	BDA216	Statistical Inference	4	0	0	4	4		CC
	Practicals								
5.	**DAP3551**	Machine Learning Lab	0	0	4	4	2(was 1)	Co-requisite BDA303	CC
6.	**DAP3552**	Statistical Simulation Lab	0	0	4	4	2(was 1)	Co-requisite BDA322	CC
7.	**DAR3551**	Research Based Learning-III (RBL-3)	0	0	0	0	0	Pre-requisite DAR2452	Research Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons./Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2702 (Semester-VI)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA321	Non-Parametric Statistical Inference	4	0	0	4	4		Minor
2.	BDA218	Data Ware Housing and Data Mining	3	0	0	3	3		Minor
3.	BDA325	Deep Learning	3	0	0	3	3		DSE
	Practicals								
4.	BDA270	Data Ware Housing and Data Mining Lab	0	0	2	2	1	Co-requiste MSM312	Minor
5	AI3409	Advanced Machine Learning Techniques	0	0	8	8	4		Minor
6.	ARP306	Campus to Corporate	1	0	2	3	2	AEC	AEC
7.	INC001	Industry Connect	0	0	4	4	2		Project
8.	**DAR3652**	Research Based Learning-IV (RBL-4)	0	0	2	2	1	Pre-requisite DAR3551	Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytic Batch: 2025-29
TERM: 2801 (Semester-VII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA101	Foundations of Data Science	4	0	0	4	4		CC
2.	MDA102	Mathematics for Machine Learning	4	0	0	4	4		CC
3.	**STT4701**	Distributions Theory	4	0	0	4	4		CC
4.	**STT4704**	Probability & Statistical Methods	4	0	0	4	4		CC
5.	MDA203*(remove because we did not give them a minor degree)	Soft Computing Techniques	4	0	0	4	4*		Minor
	Practical's								
6.	**DAP4754**	Data Science Lab	0	0	2	2	1	Co-requisite MDA101	CC
7.	**DAP4755**	Mathematics for Machine Learning Lab	0	0	2	2	1	Co-requisite MDA102	CC
8.	**STP4753**	Distributions Theory Lab	0	0	2	2	1	Co-requisite STT4701	CC
9.	**STP4752**	Statistical Methods Lab	0	0	2	2	1	Co-Requisite STT4704	CC
TOTAL CREDITS							**20/ *24**		

***Only for the students going for Apprenticeship & requires minor with major degree.**

***Credited Research Project/Dissertation:** Students of B.Sc. Data Science & Analytics have the option to choose a research project/dissertation of worth 12 credits (However student has to take 23 credits courses including 3 credits project in 7th semester and 17 credits courses including 9 credits project in 8th semester). This can be undertaken for those who secure 75% and above marks/CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a mathematics faculty member of the Sharda University. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded **B.Sc. (Hons. with Research) Data Science & Analytics.**

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons./Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2802 (Semester-VIII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6.VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA117	Computational Intelligence	4	0	0	4	4		Minor
2.	MDA104	Next Generation Databases	4	0	0	4	4		Minor
3.	MDA107	Advanced Big Data and Text Analytics	4	0	0	4	4		DSE
4.	MDA105	Regression Analysis and Predictive Models	4	0	0	4	4		DSE
	Practicals								
5.	**DAR4856**	Project	0	0	8	8	4		Project
TOTAL CREDITS							**20**		

OR

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons. /Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2802 (Semester-VII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA101	Foundations of Data Science	4	0	0	4	4		CC
2.	MDA102	Mathematics for Machine Learning	4	0	0	4	4		CC
3.	**STT4701**	Distributions Theory	4	0	0	4	4		CC
4.	**STT4704**	Probability & Statistical Methods	4	0	0	4	4		CC
5.	MDA203	Soft Computing Techniques	4	0	0	4	4		Minor
6.	**DAR4757**	Research Project-I	0	0	6	6	3		Project
TOTAL CREDITS							**23**		

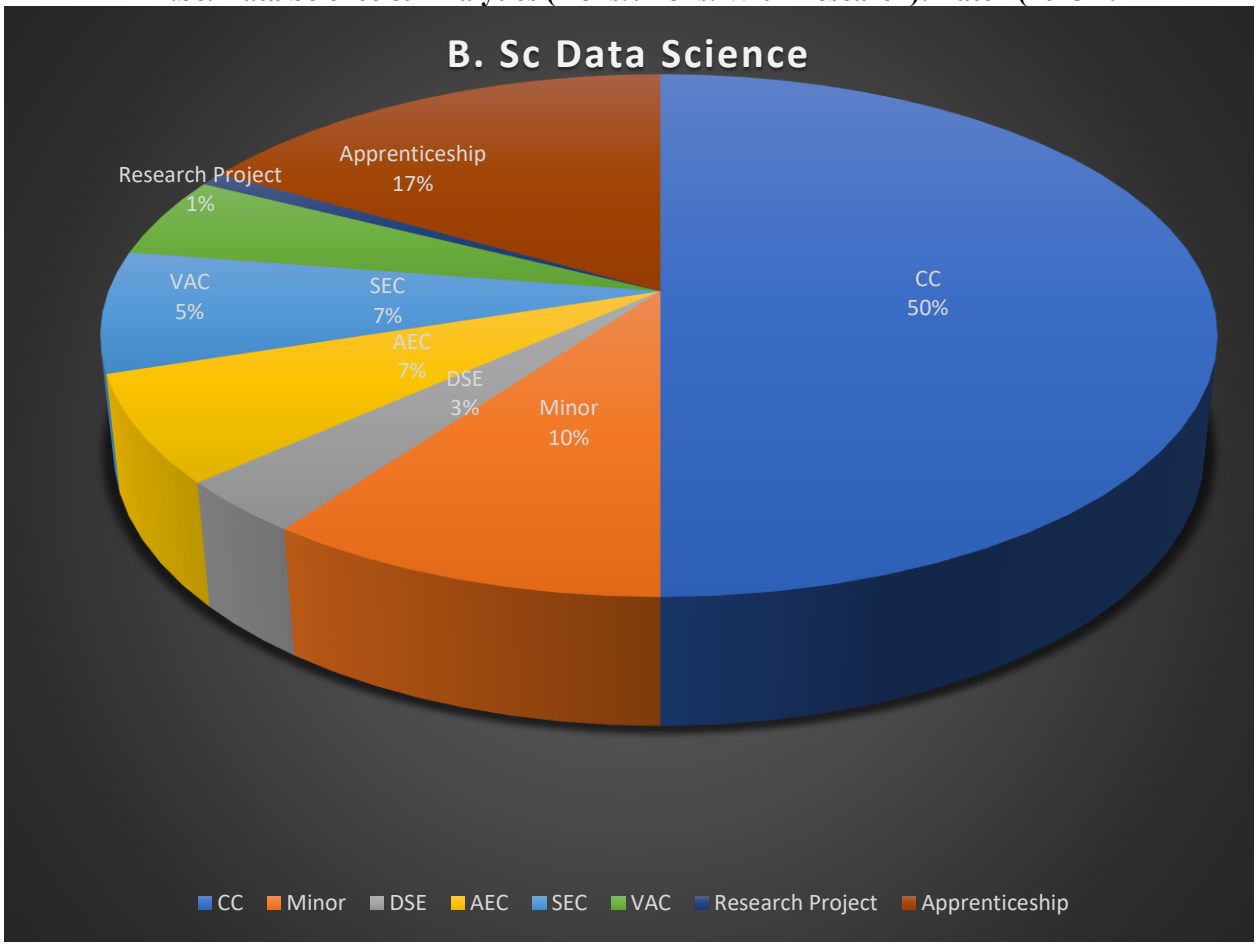
Department of Mathematics & Data Science
Sharda School of Engineering & Science
Programme Structure Template
B. Sc. (Hons./Hons. With Research) Data Science & Analytics Batch: 2025-29
TERM: 2802 (Semester-VIII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA117	Computational Intelligence	4	0	0	4	4		CC
2.	MDA112	Econometrics	4	0	0	4	4		CC
3.	**DAR4858**	Research Project-II	0	0	18	18	9		Project
TOTAL CREDITS							**17**		

***Credited Research Project/Dissertation:** Students of B.Sc. Data Science & Analytics have the option to choose a research project/dissertation of worth 12 credits (However student has to take 23 credits courses including 3 credits project in 7th semester and 17 credits courses including 9 credits project in 8th semester). This can be undertaken for those who secure 75% and above marks/CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a mathematics faculty member of the Sharda University. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded **B.Sc. (Hons. with Research) Data Science & Analytics.**

B. Sc. (Hons./Hons. With Research) Data Science & Analytics Curriculum Credits Distribution

Sem	CC	DSE	MINOR	SEC	AEC	VAC	Project	Mathematics	Computer Science	Statistics
1	8	2	3	3	2	2	0	4	2	7
2	8	0	3	3	2	4	0	4	4	3
3	10	2	3	3	2	0	0	0	2	16
4	14	0	3	0	2	0	1	3	4	10
5	20	0	0	0	0	0	0	0	0	20
6	0	3	12	0	2	0	3	0	7	8
Total:	60	**7**	**24**	9	**10**	6	**4**	11	**19**	**64**
%	**50**	**5.84**	**20**	**7.5**	**8.4**	**5**	**3.3**	**9.16**	**15.8**	**53.3**
7	20	0	4*	0	0	0	0	0	6	14
8	0	8	8	0	0	0	4	0	3	16
Total:	80	**15**	**32**	9	**10**	6	**8**	**11**	**28**	**94**
%	**50**	**9.37**	**20**	**5.63**	**6.25**	**3.75**	**5**	**6.8**	**17.5**	**58.75**



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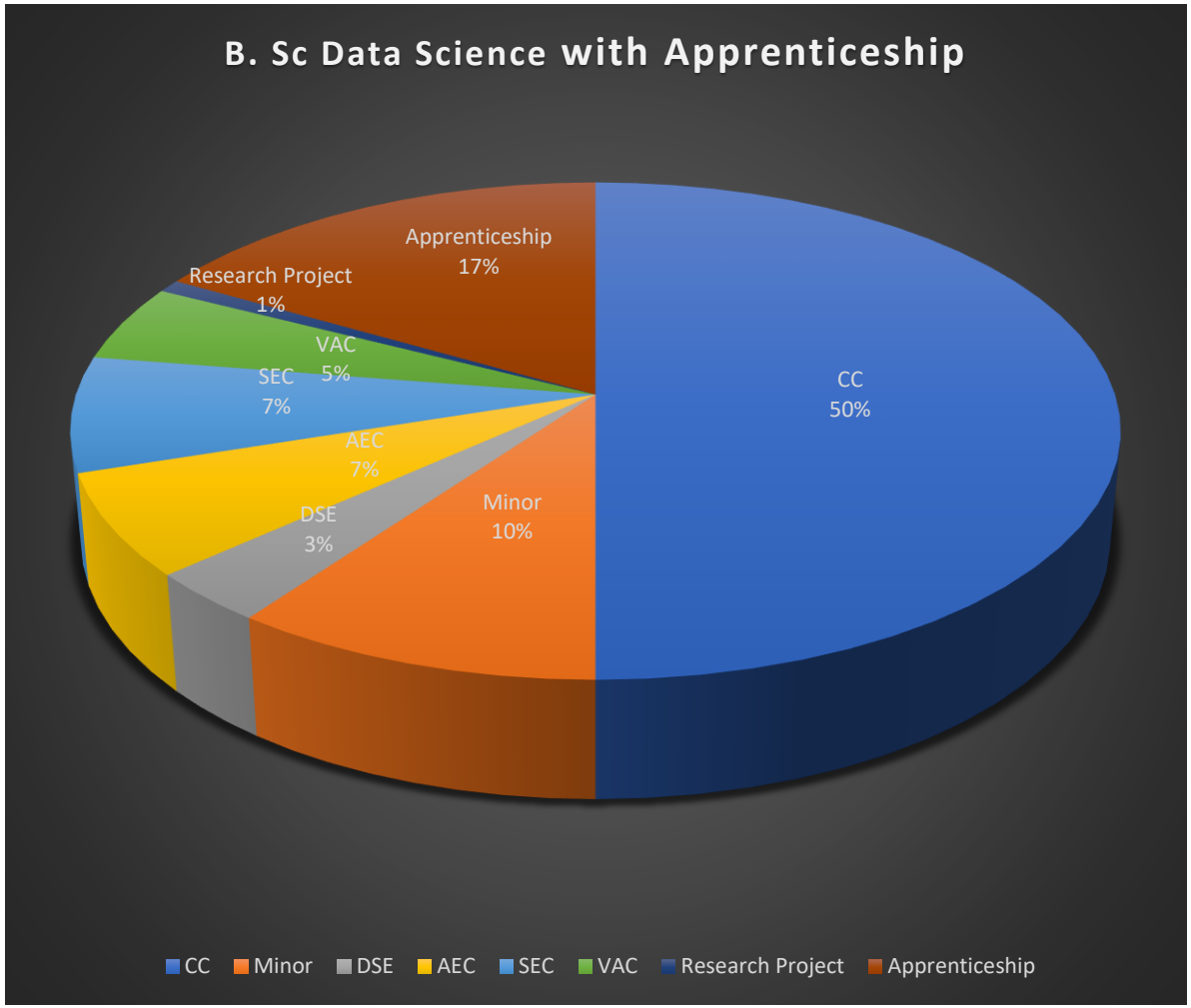
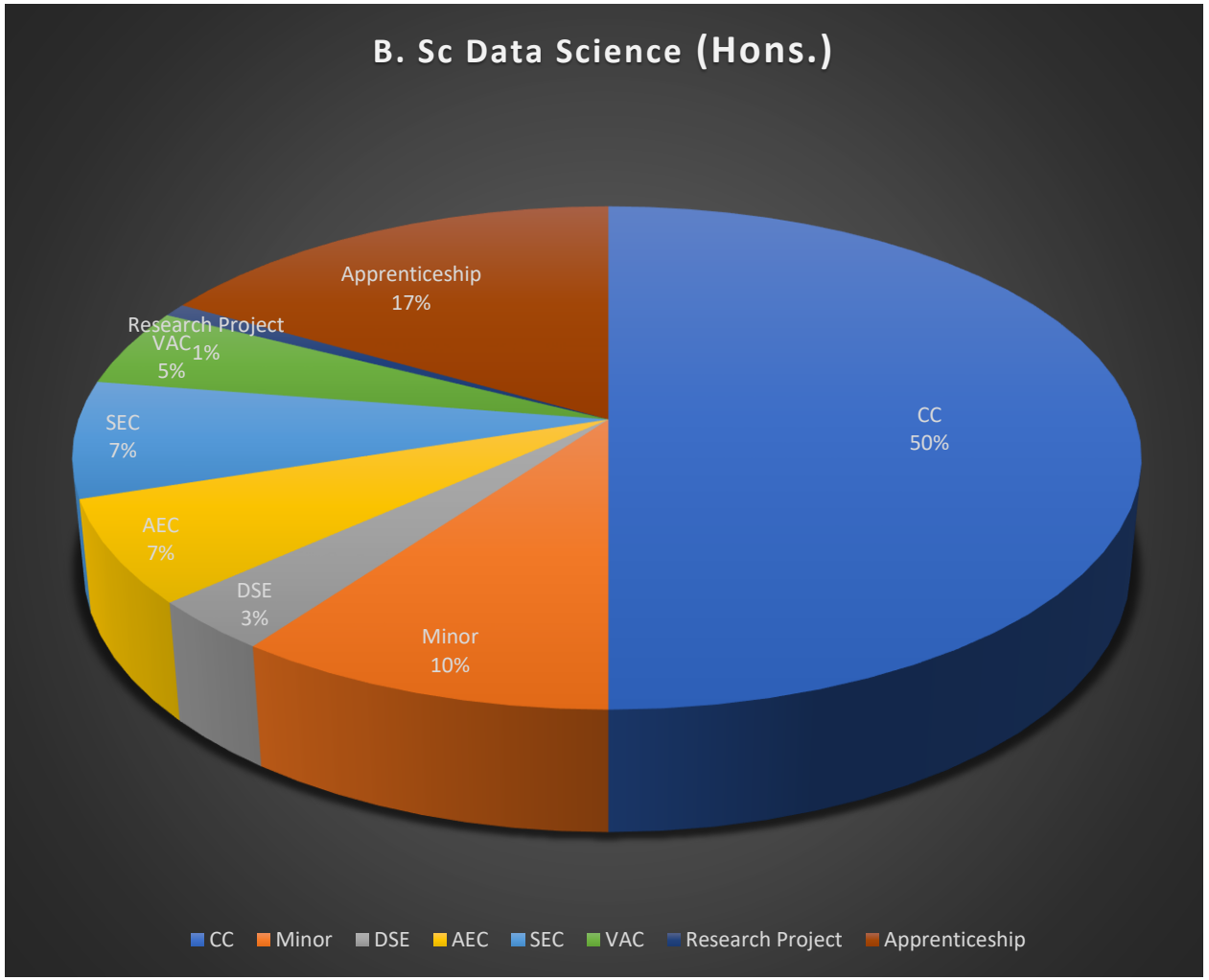
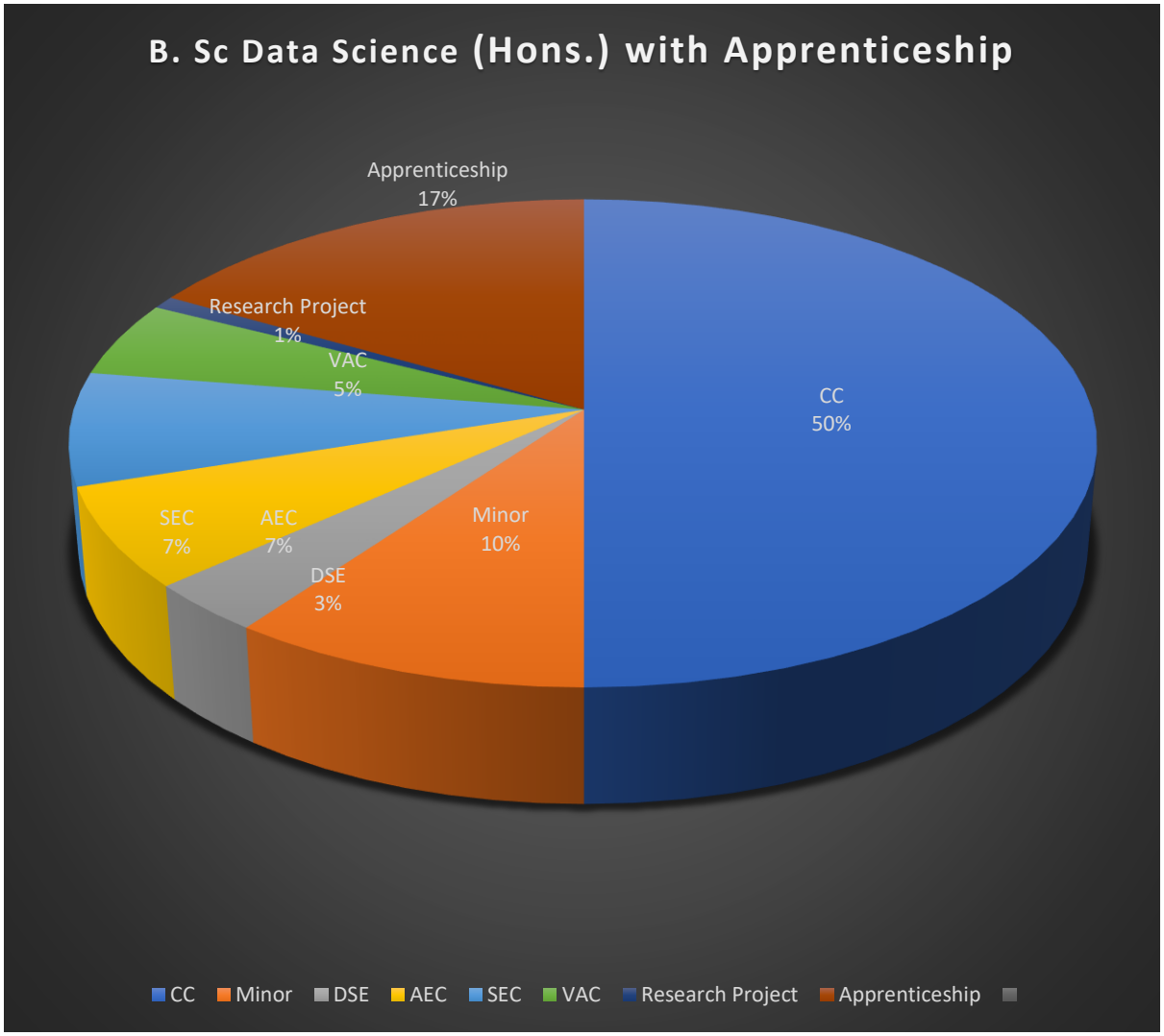
Credit Distribution of B. Sc Data Science



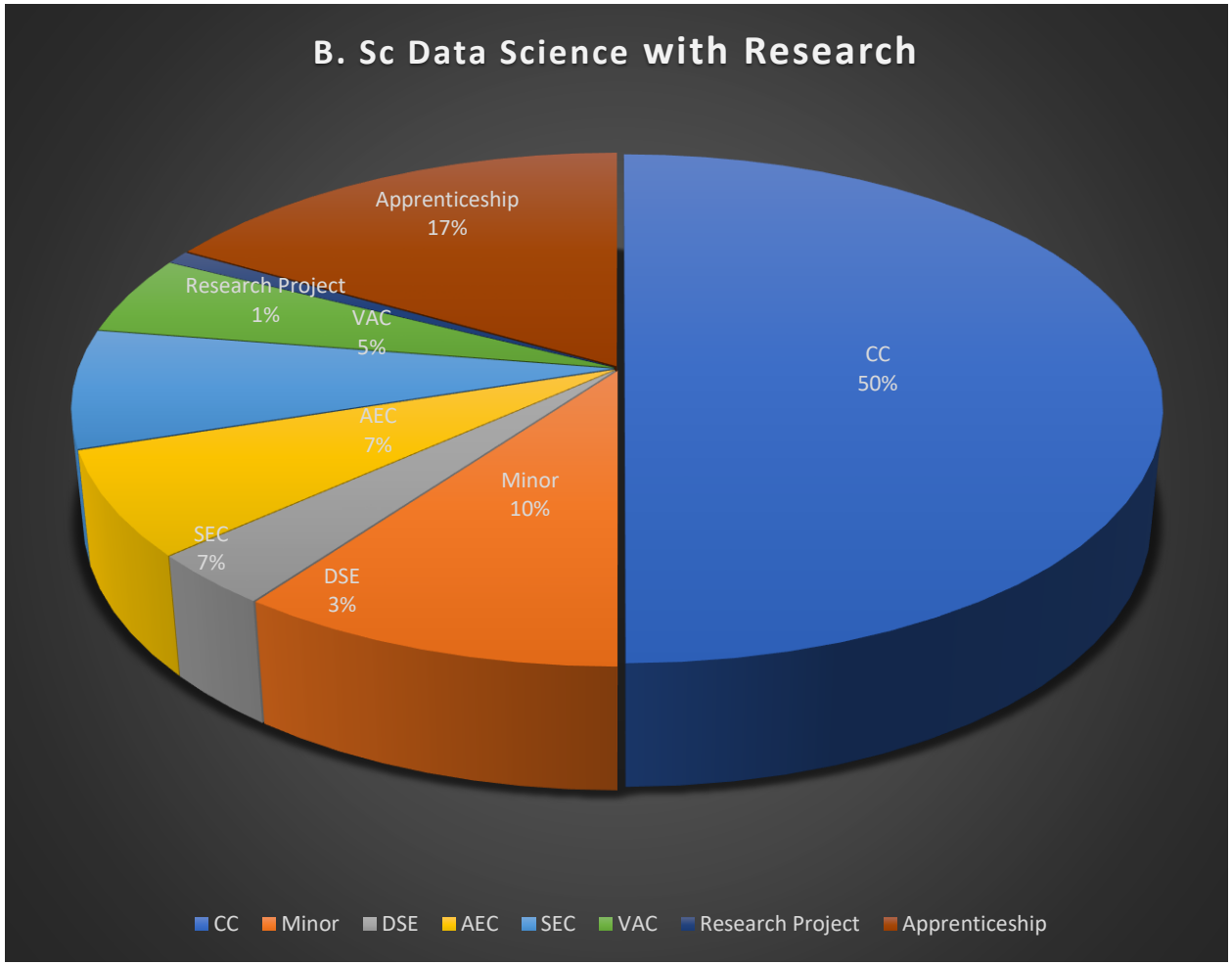
Credit Distribution of B. Sc Data Science with Apprenticeship



Credit Distribution of B. Sc Data Science (Hons.)



Credit Distribution of B. Sc Data Science (Hons.) with Apprenticeship



Credit Distribution of B. Sc Data Science with Research

COURSE ARTICULATION MATRIX

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MSM101	2.3	2.6	2.0	2.1		1.0					1.0			
DAT1101		2.0	1.0	2.0		1.0		3.0			2.0		1.0	1.0
CMS102	2.3	2.6	2.0	2.1		1.0					1.0	1.0		
MTT1101	3.0	2.0	2.0	2.0	2.0				1.0		1.0			
EVT1129	3.0	3.0	2.0	1.0	3.0	1.0	1.0	3.0	3.0	2.0	2.0	2.0	1.0	1.0
DAP1151	1.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
ARP101	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		1.0			
VOM103		2.0	1.0	2.0		1.0		3.0			1.0	1.0		
CMS131	2.5	2.5	2.5	2.6		1.0					1.0		1.0	
MTT1202	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		1.0	1.0		
MTP1251	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		2.0	1.0		
CMS132	2.3	2.6	2.0	2.1		1.0					1.0	1.0	1.0	
VOM104	2.0	1.0	2.0		1.0		3.0					1.0	1.0	
ARP102	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0					
VAC110	2.0			1.0	1.0		2.0	2.0	1.0					
VAC120														
BDA217	2.0	1.0	2.0		1.0		3.0			2.0		1.0	1.0	
BDA313	3	3	3	3	2	2	2	2	2	3	3	3	3	3
BDA215	1.0	2.0	2.3	2.1	1.0	1.0	1.0	2.0	3.0		1.0			
XXXIL														
DAP2351	1.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
AI3407	2.5	2.7	2.2	2.3	2.3	1.7	1.8	1.8	1.7	1.7				
VOM2305	2.0	1.0	2.0		1.0	2.0	3.0	2.0		2.0			1.0	
DAR2351	2.3	2.6	2.0	2.1	1.0	1.0					2.0	1.0		
BDA202	2.3	2.6	2.0	2.1		1.0					1.0	1.0		
BDA214	2.3	2.6	2.0	2.1		1.0					1.0	1.0	1.0	
BDA323	2.3	2.6	2.0	2.1	2.0	1.0					2.0	2.0		
DAP2452	1.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	1.0		2.0	1.0		
AI3408	2.0	1.0	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CCU108	1.0	2.0	2.0	3.0	3.0	2.0	3.0	3.0	3.0	2.0	1.0	2.0	2.0	3.0
DAR2452	2.3	2.6	2.0	2.1	1.0	1.0					1.0	1.0	2.3	
BDA303	2.3	2.6	2.0	2.1		1.0					3.0	3.0		
BDA322	2.3	2.6	2.0	2.1	2.0	1.0					2.0	2.0		
BDA318	2.3	2.6	2.0	2.1	2.0	1.0					2.0	2.0	2.3	2.6
BDA216	2.3	2.6	2.0	2.1		1.0					1.0	1.0	1.0	1.0
DAP3551	1.0	2.0	2.0	2.0	2.0	1.0	1.0	3.0	1.0	2.0	3.0	2.0	2.0	3.0
DAP3552	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		3.0	1.0	2.0	3.0
DAR3551		2.0	1.0	2.0	2.0	1.0		3.0			2.0	2.0	2.0	2.0

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA321		2.0	1.0	2.0		1.0		3.0			1.0	1.0		
BDA218	2.3	2.6	2.0	2.1		1.0					1.0	1.0		
BDA325	2.3	2.6	2.0	2.1		1.0					1.0	1.0		
BDA270	1.0	2.0	2.0	2.0	2.0	1.0	1.0	3.0	1.0	1.0	2.0	1.0	2.0	2.0
AI3409	2.0	1.0	2.0	2.0	1.0	3.0	1.0	3.0	1.0	1.5	2.0			
ARP306			2.0	2.0		3.0	1.0	3.0	1.0		2.0			
INC001	2.0	1.0	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
DAR3652				2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0	1.0
MDA101	2.3	2.6	2.0	2.1		1.0					3.0		3.0	
MDA102	2.3	2.6	2.0	2.1		1.0					3.0		3.0	
STT4701		2.0	1.0	2.0		1.0		3.0			3.0		1.0	1.0
STT4704	2.3	2.6	2.0	2.1		1.0					3.0		3.0	
MDA203*	2.3	2.6	2.0	2.1		1.0					3.0		3.0	
MDA155				2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
MDA158				2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
MDA156				2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
MDA157				2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0	1.0	2.0	3.0
MDA117		2.0	1.0	2.0		1.0		3.0			3.0		1.0	1.0
MDA112		2.0	1.0	2.0		1.0		3.0			3.0	1.0	1.0	1.0
MDA107		2.0	1.0	2.0		1.0		3.0			3.0	3.0	3.0	
MDA116		2.0	1.0	2.0		1.0		3.0			3.0	3.0	3.0	
XXPJECT														

1. Slight (Low) ***2. Moderate (Medium)*** ***3. Substantial (High)***

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**MSM101**	
2	Course Title	**Foundation Course in Mathematics**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	1. To familiarize the students with basic concepts of matrices, determinants, and solving the system of linear equations. 2. To understand the basic concept of sets theory, co-ordinate geometry, complex number, and vector algebra.	
6	Course Outcomes	CO1: Explain the concept of matrices and solve systems of linear equations and determinants. (K2, K3, K4) CO2: Explain the concept of complex numbers and calculate the nth roots of complex numbers and illustrate the solutions of simple Polynomial equations. (K2, K3, K4) CO3: Memorize the basic of Cartesian coordinate system and use algebraic techniques to explain intercepts and explore equations of lines on the number plane. (K1, K3, K4) CO4: Describe and differentiate the symmetries from graphs of conic sections. (K1, K2) CO5: Describe and use the concepts of set theory, relation and functions. (K1, K2, K3) CO6: Explain the basic concepts of vector algebra and use to find area of parallelogram and quadrilateral, Vector triple product. (K2, K3, K4)	
7	Course Description	This course is an introduction to the fundamental of Mathematics. The primary objective of the course is to develop the basic understanding of linear algebra, complex number, co-ordinate geometry, sets theory and vector algebra	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Matrices**	
	A	Evaluation of determinants, Properties of determinants,	CO1
	B	Matrices: types of matrices, addition, subtraction and multiplication of matrices, symmetric and skew-symmetric matrix. Inverse of matrix.	CO1
	C	Rank of a matrix, Consistency of system of equations, Characteristic equation, Cayley -Hamilton theorem.	CO1
	Unit 2	**Complex Numbers**	
	A	Representation of complex number in Argand plane, Modulus and argument of complex number	CO2
	B	Algebraic operations, De- Moivre's theorem	CO2
	C	Nth root of complex number, Euler's formula	CO2
	Unit 3	**Co-ordinate geometry**	
	A	Cartesian coordinate system, Distance between two points Equations of line in various forms	CO3
	B	Equation of circle in various forms, Equation of tangent and normal to the circle.	CO3, CO4

	C	Equation of ellipse, parabola and hyperbola	CO3, CO4
	Unit 4	**Set Theory**	
	A	Definition of set, types of sets, Union and the intersection of sets, Venn diagram, De-Morgan's law.	CO5
	B	Relation and functions.	CO5
	C	Composite function and inverse function.	CO5
	Unit 5	**Vector Algebra**	
	A	Addition and subtraction of vectors and their geometric application.	CO6
	B	Scalar and vector product, their physical application, Projection of vector on another vector, area of the triangle.	CO6
	C	Area of parallelogram and quadrilateral, Vector triple product.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	1. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons Inc. 2. Jain, M.K., and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publications	
	Other References	1. Thomas, B.G., and Finny R.L., "Calculus and Analytical geometry", Pearson Education Asia, AdisonWisley. 2. Simmons, G.F., "Differential Equations with applications with applications", Tata McGraw-Hill.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MSM101.1	3	3	2	2		1					1			
MSM101.2	2	3	3	2		1					1			
MSM101.3	2	2	2	3		1					1			
MSM101.4	2	3	2	2		1					1			
MSM101.5	3	3	2	2		1					1			
MSM101.6	3	3	2	3		1					1			
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**			

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**DAT1101**	
2	Course Title	**Foundation of Data Science**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	CC	
5	Course Objective	To make students familiar with Data Science concepts, tools, and techniques, and to develop their skills in data analysis, visualization, and basic Machine Learning through hands-on projects, preparing them for advanced studies and careers in the field.	
6	Course Outcomes	CO1: Understand the fundamental concepts of Data Science and its applications. (K1, K3) CO2: Apply basic statistical techniques for data analysis. (K2, K3, K4) CO3: Perform data preprocessing, handling, and visualization. (K2, K3, K4) CO4: Understand the basics of Machine Learning techniques. (K2, K6) CO5: Develop basic programming skills for data science (Python/R) (K1, K2) CO6: Implement small-scale projects for real-world data analysis.	
7	Course Description	This course introduces to the fundamental concepts, tools, and techniques of Data Science, covering data analysis, preprocessing, visualization, and basic Machine Learning.	
8			
	Unit 1		
	A	**Introduction to Data Science** Definition, scope, and evolution of Data Science. Real-world applications (Healthcare, Finance, Marketing, etc.). Overview of Big Data and its challenges	CO1
	B	Structured vs. Unstructured Data. Data types (Numerical, Categorical, Time Series, Text Data). Overview of datasets	CO1
	C	Data Collection, Preprocessing, Analysis, Visualization, and Model Building.	CO1
	Unit 2		
	A	Measures of Central Tendency (Mean, Median, Mode).	CO2
	B	Measures of Dispersion (Variance, Standard Deviation, Range).	CO2
	C	Scatter diagram, covariance, Correlation	CO2
	Unit 3		
	A	**Data Cleaning & Preprocessing** Handling missing values, removing duplicates, and outliers. Data transformation (Normalization, Standardization).	CO3
	B	**Data Manipulation in Python/R** Working with NumPy and Pandas. Filtering, Sorting, Grouping, and Aggregation.	CO3
	C	**Data Visualization Techniques** Basics of Matplotlib and Seaborn.	CO3

		Types of Graphs: Bar Charts, Histograms, Box Plots, Scatter Plots, Line Graphs, Heatmaps, and Pair Plots.	
	Unit 4		
	A	**Introduction to Linear Regression** Understanding the Regression Equation. Assumptions of Linear Regression. Model Evaluation Metrics (MSE, RMSE, R^2).	CO4
	B	**Introduction to Classification Models** Decision Trees (Basic Concepts).	CO4
	C	**Introduction to Clustering** K-Means Algorithm.	CO4
	Unit 5	**Programming for Data Science**	
	A	**Introduction to Python/R for Data Science** Basic Syntax, Data Types, and Operators. Control Structures (Loops & Conditional Statements). Functions and Modules.	CO5
	B	**Working with Data Science Libraries** NumPy (Array Operations). Pandas (DataFrame Operations). Scikit-Learn (Basic ML Models).	CO5
	C	**Project Development Process** Problem Identification and Data Collection. Data Cleaning and Exploration. Model Selection and Implementation. Result Interpretation and Presentation.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE :25% ; ETE:50%	
	Text book/s*	1. **"Python for Data Analysis" by Wes McKinney** 2. **Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce**	
	Other References	1. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron**	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAT1101.1		2	1	2		1		3			2		1	1
DAT1101.2		2	1	2		1		3			2		1	1
DAT1101.3		2	1	2		1		3			2		1	1
DAT1101.4		2	1	2		1		3			2		1	1
DAT1101.5		2	1	2		1		3			2		1	1
DAT1101.6		2	1	2		1		3			2		1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**2.0**		**1.0**	**1.0**

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**CMS102**	
2	Course Title	**Descriptive Statistics**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	OPE	
5	Course Objective	1. To introduce basic statistical concepts, logic and analytical tools, analyze and communicate quantitative data verbally, graphically, symbolically, and numerically. 2. To make students familiar with the concept of Probability and Statistics and display data utilizing various tables, charts, and graphs.	
6	Course Outcomes	CO1: Describe the process and particular steps in designing studies, collecting and analyzing data, interpreting and presenting results; and developing skills in presenting quantitative data using appropriate diagrams, tabulations, and summaries. (K2, K5). CO2: Describe the properties of discrete and continuous distribution functions. (K2). CO3: Calculate the measures of central tendency and dispersion of data and describe the method used for analysis, including a discussion of advantages, disadvantages, and necessary assumptions. (K2, K3) CO4: Calculate and interpret the correlation between two variables, Calculate the simple linear regression equation for a set of data and know the basic assumptions behind regression analysis. (K2,K3). CO5: Understand the line of best fit as a tool for summarizing a linear relationship and predicting future observed values, and develop the ability to use formal mathematical argument in the context of probability. (K2, K5) CO6: Develop the skills to interpret the results of statistical analysis. (K2, K5).	
7	Course Description	This is an introductory course in statistics. Students are introduced to the fundamental concepts involved in using sample data to make inferences about populations. Included are the study of measures of central tendency and dispersion, finite probability, statistical inferences from large and small samples, linear regression, and correlation.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Presentation of data**	
	A	Classification, tabulation, diagrammatic & graphical representation of grouped data.	CO1
	B	Frequency distributions, cumulative frequency distributions	CO1
	C	Histogram, Ogives, frequency polygon, Tree and leaf diagram.	CO1
	Unit 2	**Descriptive statistics**	CO2
	A	Measures of central tendency – arithmetic mean, median, quartiles, mode, harmonic mean, geometric mean.	CO2
	B	Their properties, merits, and demerits	CO2
	C	Measures of dispersion, range, quartile deviation, mean deviation, standard deviation, and coefficient of variation.	
	Unit 3	**Moments**	CO3
	A	Moments, Skewness, Measures of skewness: Karl Pearson's coefficient of skewness.	CO3
	B	Quartile, coefficient of skewness, Measure of skewness based on moments.	CO3
	C	Kurtosis, Measures of Kurtosis.	
	Unit 4	**Bi-variate data analysis**	CO4

	A	Bivariate data, principles of least squares, fitting of polynomial curves, and fitting ofcurves reducible to polynomial form.	CO4
	B	Correlation: Spearman's rank correlation, Partial and Multiple Correlation (only two independent variables case).	CO4
	C	Regression lines.	
	Unit 5	**Probability**	CO5
	A	Probability: Introduction, random experiment, outcomes, sample space, events, various definitions of probability, laws of total and compound probability.	CO5
	B	Boole's inequality. Conditional probability, independence of events.	CO5
	C	Bayes theorem and its applications in real-life problems.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE :25% ; ETE:50%	
	Text book/s*	1. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2. Rohatgi, V.K. "Introduction to Probability".	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CMS102.1	3	3	2	2		1					1	1		
CMS102.2	2	3	3	2		1					1	1		
CMS102.3	2	2	2	3		1					1	1		
CMS102.4	2	3	2	2		1					1	1		
CMS102.5	3	3	2	2		1					1	1		
CMS102.6	3	3	2	3		1					1	1		
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**		

School: SSES		**Batch : 2025-29**	
Program: (Hons. /Hons. With Research)		**Current Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester:1**	
1	Course Code	**MTT1101**	Course Name: Programming for problem solving
2	Course Title	Programming for problem solving	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	DSE	
5	Course Objective	1. Learn basic programming constructs –data types, decision structures, control structures in C 2. Learning logic aptitude programming in c language 3. Developing software in c programming	
6	Course Outcomes	Students will be able to: **CO1**: Analyze a problem and represent its solution using algorithms, pseudo-code, and flowcharts. (K2, K3, K4). **CO2**: Apply fundamental concepts of C programming, including data types, operators, and control structures, to solve problems. (K2, K3, K4). **CO3**: Develop and implement programs using loops, functions, and arrays for structured problem-solving. (K1,K2). **CO4**: Utilize pointers and strings effectively to manage memory and text-based data processing. (K2, K3, K4). **CO5**: Implement user-defined data types, structures, and file handling techniques for data organization and storage. **CO6**: Design and develop optimized C programs to address real-world computational problems.	
7	Course Description	Programming for problem solving gives the Understanding of C programming and implement code from flowchart or algorithm	
8	Outline syllabus		CO Mapping
	Unit 1	**Logic Building**	
	A	Flowchart: Elements, Identifying and understanding input/ output, Branching and iteration in flowchart	CO1,
	B	Algorithm design: Problem solving approach(top down/bottom up approach)	CO1
	C	Pseudo Code : Representation of different construct,	CO1

		writing pseudo-code from algorithm and flowchart	
	Unit 2	**Introduction to C Programming**	
	A	Introduction to C programming language, Data types, Variables, Constants, Identifiers and keywords, Storage classes	CO2, CO6
	B	Operators and expressions, Types of Statements: Assignment, Control, jumping.	CO2, CO6
	C	Conditional statements: if, if-else, nested if-else, switch case, break, continue	CO2, CO6
	Unit 3	**Loops and Arrays**	
	A	Iterative Statements: while loop, for loop, and do-while loop	CO3, CO6
	B	Arrays: One dimensional: Declaration, Initialization (sorting, searching).	CO3, CO6
	C	Multi dimensional arrays: Declaration, Initialization, Array manipulation (Matrix operations)	CO3, CO6
	Unit 4	**Functions**	
	A	Functions: Definition, Declaration/Prototyping and Calling,	CO4, CO6
	B	Types of functions, Parameter passing: Call by value, Call by reference.	CO4, CO6
	C	Passing and Returning Arrays from Functions, Recursive Functions.	CO4, CO6
	Unit 5	**Pointers, String and Structures**	
	A	Pointer: Introduction, declaration of pointer variables, Operations on pointers: Pointer arithmetic.	CO5, CO6
	B	String: Introduction, predefined string functions, Manipulation of text data.	CO5, CO6
	C	Structure and Unions: Introduction, Declaration, Difference, Application, Nested structure, self-referential structure.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		25% / 25% / 50%	
	Text book/s*	Kernighan, Brian, and Dennis Ritchie. *The C Programming Language*	
	Other References	1. B.S. Gottfried - Programming With C - Schaum's Outline Series - Tata McGraw Hill 2nd Edition - 2004.	

		2. E. Balagurusamy - Programming in ANSI C - Second Edition - Tata McGraw Hill- 1999.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MTT1101.1	3	3	2	2		1					1			
MTT1101.2	2	3	3	2		1					1			
MTT1101.3	2	2	2	3		1					1			
MTT1101.4	2	3	2	2		1					1			
MTT1101.5	3	3	2	2		1					1			
MTT1101.6	3	3	2	3		1					1			
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**			

School: SSES		**Batch: 2025-29**
Program: (Hons. /Hons. With Research)		**Current Academic Year: 2025-26**
Branch: Data Science & Analytics		**Semester: I**
1	**Course Code**	**EVT1129**
2	Course Title	Environmental Education
3	Credits	02
4	Contact Hours (L-T-P)	2-0-0
	Course Status	Compulsory
5	Course Objective	1. Enable students to learn the concepts, principles and importance of environmental science. 2. Provide students an insight of various causes of natural resource depletion and its conservation. 3. Provide detailed knowledge of causes, effects and control of different types of environmental pollution and its effect on climate change, global warming and ozone layer depletion. 4. Provide knowledge of different methods of water conservation. 5. Provide and enrich the students about sustainable practices and environmental management.
6	Course Outcomes	CO1.Develop a better understanding of the principles and scope of environmental science. CO2. Acquire to learn various pollution causes, effects and control and solid waste management. CO3. Interpret the effect of global warming and ozone layer depletion. CO4. Comprehend about various types of natural resources and its conservation. CO5. Develop a better understanding about sustainable practices and environmental management. CO6. Function effectively on overall understanding of various environmental components, its protection and management.
7	Course Description	Environmental Science emphasises on various factors as 1. Importance and scope of environmental science 2. Natural resource conservation 3. Pollution causes, effects and control methods 4. Sustainable and environmental protection
8	Outline syllabus	CO Mapping

	Unit 1	**Humans and the Environment**	
	A	The man-environment interaction: Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation.	CO1
	B	The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development.	CO1
	C	The concept of sustainable development; Rio Summit and subsequent international efforts.	CO1
	Unit 2	**Natural Resources and Sustainable Development**	
	A	Overview of natural resources: Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: forests, grasslands, wetlands, wildlife and aquatic, water resources.	CO2
	B	Renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy.	CO2
	C	Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells. Introduction to sustainable development: Sustainable Development Goals (SDGs).	CO2
	Unit 3	**Environmental Issues: Local, Regional and Global**	
	A	Environmental issues and scales: local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste.	CO3/CO6
	B	Land use and Land cover change: land degradation, deforestation, desertification, urbanization.	CO3/CO6
	C	Global change: Ozone layer depletion, Sources and impact on human health and ecosystems.	CO3/CO6
	Unit 4	**Conservation of Biodiversity and Ecosystems**	
	A	Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots.	CO4/CO6
	B	Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics forests, wetlands, grasslands, agriculture, coastal and marine	CO4/CO6
	C	Threats to biodiversity and ecosystems. Major conservation policies: in-situ and ex-situ conservation approaches.	CO4/CO6
	Unit 5	**Climate Change: Impacts, Adaptation and Mitigation**	
	A	Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events.	CO5/CO6
	B	Global warming effects, Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality.	CO5/CO6

	C	National and international policy instruments for mitigation, and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan.			CO5/CO6
	Mode of examination	Theory based survey			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text book/s*	Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha, Pub: Orient Blackswan Pvt Ltd			
	Other References	Environmental Science by G. Tyler Miller, JR. and Scott E. Spoolman; Broks/Cole.			

Course Articulation Matrix

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-
CO2	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-
CO3	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-
CO4	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-
CO5	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-
CO6	3	3	2	1	3	1	1	3	3	2	2	2	1	1	-

1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**DAP1151**	
2	Course Title	**Foundation of Data Science Lab**	
3	Credits	1	
4	Contact Hours(L-T-P)	0-0-2	
	Course Status	CC	
5	Course Objective	To make students familiar with the concepts of preparing your data; Working with dates and times, Data Cleaning, Data Structure, and Cleaning Text Data.	
6	Course Outcomes	CO1: Describe preparing data: Rearranging and removing variables, renaming variables, Variable classes, calculating new numeric variables, and explaining how to Dividing a continuous variable into categories, Working with factor variables. (K1, K3) CO2: Discuss how to work with dates and times, add and remove observations and explain about removing duplicate observations, selecting a subset of the data, selecting a random sample from a dataset, and sorting a dataset. (K2, K3, K4) CO3: Explain the data cleaning and technical representation of data. (K2, K3, K4) CO4: Discuss the data structure. (K2, K6) CO5: Describe Character Normalization, Encoding Conversion and Unicode Normalization, Character Conversion, and Transliteration. (K1, K2) CO6: Discuss and evaluate Generating Regular Expressions in R, Common String Processing Tasks in R, Approximate Text Matching, String Metrics, String Metrics, and Approximate Text Matching in R.	
7	Course Description	This course introduces preparing your data; Working with dates and times, Data Cleaning, Data Structure, and cleaning Text Data.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Lab. Experiment 1: Introduction to Python/R for Data Science	
	A, B, C	Install and set up Python/R environment (Anaconda, Jupyter Notebook, RStudio). Write basic Python/R scripts: Variables, Data Types, Operators, and Control Structures. Perform basic operations using NumPy (Python) or basic R functions.	CO1, CO2
	Unit 2	**Lab. Experiment 2: Data Cleaning and Preprocessing**	
	A, B, C	Load a dataset (CSV/Excel) into Python/R.Handle missing values (imputation, removal).Remove duplicates and outliers. • Normalize and standardize data	CO2, CO3
	Unit 3	**Lab. Experiment 3: Data Manipulation**	
	A, B, C	Use Pandas (Python) or dplyr (R) for data manipulation. Filter, sort, group, and aggregate data.Merge and join datasets	CO3, CO4
	Unit 4	**Lab. Experiment 4: Data Visualization**	
	A, B, C	Create basic plots using Matplotlib/Seaborn (Python) or ggplot2 (R):Bar charts, histograms, scatter plots, line graphs, box plots. Customize plots (titles, labels, legends)	CO4, CO5
	Unit 5	**Lab. Experiment 5: Introduction to Machine Learning**	

	A, B, C	Implement Linear Regression using Scikit-Learn (Python) or caret (R).Evaluate models using metrics like MSE, RMSE, and R^2	CO5, CO6
	Mode of examination	Practical + Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. **Python for Data Analysis by Wes McKinney** 2. **R for Data Science by Hadley Wickham and Garrett Grolemund** 3. **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron**	
	Other References	1. Data Visualization with Python and JavaScript by Kyran Dale 2. Data Wrangling with Python by Jacqueline Kazil and Katharine Jarmul	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAP1151.1	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP1151.2	1	2	3	2	1	1	1	3	1	1	3	1	2	3
DAP1151.3	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP1151.4	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP1151.5	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP1151.6	1	2	2	2	1	1	1	3	1	1	3	1	2	3
Average	**1.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	**1.0**	**3.0**	**1.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**ARP101**	
2	Course Title	**Communicative English-1**	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
	Course Status	AEC	
5	Course Objective	To minimize the linguistic barriers that emerge in varied socio-linguistic environments through the use of English. Help students to understand different accents and standardize their existing English. Guide the students to hone their basic communication skills - listening, speaking, reading, and writing while also uplifting their perception of themselves, giving them self-confidence and building a positive attitude.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Develop a better understanding of advanced grammar rules and write grammatically correct sentences CO2: Acquire wide vocabulary and punctuation rules and learn strategies for error-free communication. CO3: Interpret texts, and pictures and improve both reading and writing skills which would help them in their academic as well as professional career CO4: Comprehend language and improve speaking skills in academic and social contexts CO5: Develop, share, and maximize new ideas with the concept of brainstorming and the documentation of key critical thoughts articulated towards preparing for a career based on their potential and availability of opportunities. CO6: Function effectively in multi-disciplinary teams through the knowledge of team work, Inter-personal relationships, conflict management, and leadership quality	
7	Course Description	The course is designed to equip students, who are at a very basic level of language comprehension, to communicate and work with ease in the varied work environment. The course begins with basic grammar structure and pronunciation patterns, leading up to apprehension of oneself through written and verbal expression as a first step towards greater employability.	
8			
	Unit 1	**Sentence Structure**	**CO Mapping**
	A	Subject Verb Agreement	CO1
	B	Parts of speech	CO1
	C	Writing well-formed sentences	CO1
	Unit 2	**Vocabulary Building & Punctuation**	
	A	Homonyms/ homophones, Synonyms/Antonyms	CO1, CO2
	B	Punctuation/ Spellings (Prefixes-suffixes/Unjumbled Words)	CO1, CO2
	C	Conjunctions/Compound Sentences	CO1, CO2
	Unit 3	**Writing Skills**	
	A	Picture Description – Student Group Activity	CO1
	B	Positive Thinking - Dead Poets Society-Full-length feature film - Paragraph Writing inculcating the positive attitude of a learner through the movie | SWOT Analysis – Know yourself	CO3

	C	Story Completion Exercise –Building positive attitude - The Man from Earth (Watching a Full-length Feature Film)	CO2, CO3
		Digital Literacy | Effective Use of Social Media	CO2, CO3
	Unit 4	**Speaking Skill**	CO3
	A	Self-introduction/Greeting/Meeting people – Self-branding	CO3
	B	Describing people and situations - To Sir with Love (Watching a Full-length Feature Film)	CO4
	C	Dialogues/conversations (Situation based Role Plays)	CO4
	Unit 5	**Professional Skills | Career Skills**	CO4
	A	Exploring Career Opportunities	CO4, CO5
	B	Brainstorming Techniques & Models	CO4, CO5
	C	Social and Cultural Etiquettes	CO4, CO5
	D	Internal Communication	CO4, CO5
	Unit 6	**Leadership and Management Skills**	
	A	Managerial Skills	CO4, CO5
	B	Entrepreneurial Skills	CO4, CO5
	Mode of examination	Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem-Solving Scenarios/GD/Simulations	
	Weightage Distribution	CA:30%; CE :30% ; ESE:40%	
	Text book/s*	Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication	
	Other References	Comfort, Jeremy (et.al). Speaking Effectively. Cambridge University Press	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
ARP101.1	1	2	2	2		1	1	3	1		1			
ARP101.2	1	2	3	2		1	1	3	1		1			
ARP101.3	1	2	2	2		1	1	3	1		1			
ARP101.4	1	2	2	2		1	1	3	1		1			
ARP101.5	1	2	2	2		1	1	3	1		1			
ARP101.6	1	2	2	2		1	1	3	1		1			
Average	**1.0**	**2.0**	**2.0**	**2.0**		**1.0**	**1.0**	**3.0**	**1.0**		**1.0**			

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**VOM103**	
2	Course Title	**Essential Excel Skills for Business**	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	SEC	
5	Course Objective	1. To be able to enter, edit, and format data with ease using the Excel user interface. 2. To do calculations on data, use formulae and functions. Utilize functions to automate selections and data searches.	
6	Course Outcomes	CO1: How to operate essential navigational controls in Excel and how to perform basic data entry with Excel spreadsheets and understand the different cell references. CO2: Explain several formatting tools like font formatting, borders, alignment, number formatting, Excel styles, themes, and printing options. CO3: Build charts to represent data visually using Pie, column, and line charts and modify chart elements. CO4: Examine multiple sheets and workbooks to combine data, manage datasets and perform calculations across multiple sources. CO5: Decide ways to extract information and manipulate data to fulfill specific business requirements using text and date functions. CO6: Create, manage, and apply Named Ranges to enhance calculations.	
7	Course Description	In offices all throughout the world, spreadsheet software continues to be one of the most frequently used programs. A significant tool will be added to your employability profile after you learn to use this software with assurance. Every day, there are millions of job postings in India alone that mention having Excel abilities. Digital skills contribute to higher income and better employment chances.	
8			
	Unit 1	**Critical Core of Excel and Performing Calculations**	
	A	Introduction, Taking Charge of Excel, Navigating and Selecting, View Options, Data Entry, Data Types, Editing and Deleting, Fill Handle, Copy and Paste, Templates.	CO1
	B	Formulas, Formulas in Context, Functions I: SUM and AUTOSUM.	CO1
	C	Functions II: AVERAGE, MIN and MAX, Absolute Cell References, Calculations across sheets.	CO1
	Unit 2	**Formatting and Printing**	
	A	Formatting, Borders, Alignment Tools, Format Painter, Number Formats, Styles, and Themes.	CO2
	B	Managing Rows and Columns, Finding and Replacing, Filtering, Sorting, Conditional Formatting.	CO2
	C	Print Preview, Orientation, Margins, Scale, Page Breaks, Print Titles, Headers, and Footers	CO2
	Unit 3	**Charts**	
	A	Basic Chart Types: Pie, Column, and Line Charts.	CO3
	B	Move and Resize Charts, Change Chart Style & Type.	CO3
	C	Modify Chart Elements.	CO3C
	Unit 4	**Working with Multiple Worksheets & Workbooks**	
	A	Multiple Worksheets, 3D Formulas, Linking Workbooks.	CO4
	B	Consolidating by Position, Consolidating by Category (Reference).	CO4
	C	Combining Text (CONCAT, &), Changing Text Case (UPPER,	CO4

		LOWER, PROPER).	
	Unit 5	**Named Ranges**	
	A	Extracting Text (LEFT, MID, RIGHT), Finding Text (FIND),	CO5
	B	Date Calculations (NOW, TODAY, YEARFRAC).	CO5
	C	Introducing Named Ranges, Creating Named Ranges, Managing Named Ranges, Named Ranges in Formulas, Apply Names.	CO6
	Mode of examination	Practical	
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*	1. Michael Alexander, Excel® Dashboards & Reports for Dummies, John Wiley & Sons, Inc, ISBN: 978-1-119-07676-6, 2016.	
	Other References	1. Michael Alexander and Dick Kusleika, Excel 2016 Formulas, John Wiley & Sons, Inc, ISBN: 978-1-119-06786-3, 2016.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
VOM103.1		2	1	2		1		3			1	1	1	
VOM103.2		2	1	2		1		3			1	1	1	
VOM103.3		2	1	2		1		3			1	1	1	
VOM103.4		2	1	2		1		3			1	1	1	
VOM103.5		2	1	2		1		3			1	1	1	
VOM103.6		2	1	2		1		3			1	1	1	
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**1.0**	**1.0**	**1.0**	

SEMESTER-2

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**CMS131**	
2	Course Title	**Matrix Analysis and Linear Algebra**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	1. To familiarize the students with basic concepts of matrices and their application in different prospects. 2. To understand the basic concept of linear algebra and inner product space.	
6	Course Outcomes	CO1: Describe the concept of the algebra of matrices and elementary row operations and calculate the rank of the matrix and analyze the consistency of a linear system. (K1, K2, K3) CO2: Explain the concept of Eigenvalues and Eigenvectors; evaluate the diagonalization of matrices and quadratic & bilinear forms. (K1, K2, K3) CO3: Discuss the basic of Vector spaces. (K2, K3, K4) CO4: Describe and use the linear transformation and evaluate nullity and kernel. (K2, K3, K4) CO5: Explain the range and kernel and the basic introduction of Inner product spaces and orthogonal and orthonormal vectors. (K4, K5) CO6: Describe the application of rank, Eigenvalues, Eigenvectors, and Gram-Schmidt orthogonalization. (K4, K5, K6)	
7	Course Description	This course introduces the basic algebra of matrices, and their applications, vector space, Linear transformation and its properties, and matrix representation of a linear transformation.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Matrix Analysis -I**	
	A	Course introduction and properties of Matrices, Elementary row operations, and Echelon form of a matrix.	CO 1
	B	Rank of a Matrix, Normal form of a Matrix, Gauss-Jordan Method: Inverse of a Matrix by elementary operations.	CO 1
	C	Application of Rank: System of linear homogeneous and non-homogeneous equations, Theorems on the consistency of a system of linear equations.	CO 1, CO 6
	Unit 2	**Matrix Analysis -II**	
	A	Eigenvalues, Eigenvectors, and characteristic equations of a matrix.	CO 2, CO 6
	B	Cayley Hamilton theorem and its application, Diagonalization.	CO 2, CO 5
	C	Quadratic forms, Matrix of quadratic forms, Bilinear forms, Matrix of bilinear forms.	CO 2
	Unit 3	**Vector space and Linear Transformations -I**	
	A	Vector Space, Vector Subspaces and Linear Span, Linear Independence, and Linear Dependence, Basic Results on Linear Independence.	CO 3
	B	Basis of a Finite Dimensional Vector Space, Linear Transformations, Results on Linear Transformation.	CO 3
	C	Range and Kernel of a Linear Transformation, Rank and Nullity,	CO 3, CO 5

		Rank-Nullity Theorem.	
	Unit 4	**Linear Transformations-II**	
	A	Linear operators, Invertible Linear Transformations.	CO 4
	B	Matrix of a Linear Transformation, Matrix of the sum and product of linear transformations.	CO 4
	C	Linear transformation of a Quadratic Form and its theorems.	CO 4
	Unit 5	**Orthogonality**	
	A	Inner Product Space (definition and examples), Cauchy- Schwartz inequality.	CO 5
	B	Orthogonal and orthonormal vectors, Orthogonal and orthonormal bases	CO 5
	C	Gram-Schmidt Process, Orthogonal, and positive definite matrices.	CO 6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	1. Strang G, Linear Algebra and its applications, 3rd edition, Thomson. 2. Krishnamurthy V, Mainra V P, Arora J L, An introduction to Linear Algebra.	
	Other References	1. Lipshutz S, Lipson M, Linear Algebra, 3rd edition, Schaum's Outline series. 2. Kreyszig E, Advanced Engineering Mathematics, John Wiley & sons.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CMS131.1	3	3	2	2		1					1		1	
CMS131.2	2	2	2	2		1					1		1	
CMS131.3	3	3	3	3		1					1		1	
CMS131.4	2	2	2	3		1					1		1	
CMS131.5	2	3	3	3		1					1		1	
CMS131.6	3	2	3	3		1					1		1	
Average	**2.5**	**2.5**	**2.5**	**2.6**		**1.0**					**1.0**		**1.0**	

School		**SSES**	
Department:		**Department of Mathematics & Data Science**	
Program:		**B. Sc. Data Science & Analytics**	
Semester:		**II**	
1	**Course Code**	**MTT1202**	**Course Name: Principal of Data Structures**
2	**Course Title**	**Principal of Data Structures**	
3	**Credits**	**3**	
4	**Contact Hours (L-T-P)**	**3-0-0**	
	Course Status	Compulsory	
5	Course Objective	This course provides programming concepts for subsequent study in Computer Science, as well as developing the skills necessary to solve practical problems.	
6	Course Outcomes	After the completion of this course, students will be able to: CO1: Apply the basic operations on arrays. CO2: Construct complex programs like matrix implementations on arrays. CO3: Apply the concept of stacks and queues in real life problem solving. CO-4: Apply the concepts of data structure, like linked list to solve complex problems. CO-5: Solving the real-life problems based on trees. CO-6: Implementing the graphs and apply graph concept in computer networks.	
7	Course Description	The purpose of this course is to understand and use data structures that are backbone of computer science. A basic understanding of data structure topics is fundamental for work in computer science. In this course we will discover taking form arrays to stacks, queues, linked list, trees and graphs including searching and sorting.	
8	Outline syllabus		CO Mapping
	Unit 1	**Arrays and Strings**	
	A	Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays	CO1, CO6
	B	Pointer, Pointer to Structure, various Programs for Array and Pointer	CO1, CO6
	C	Strings. Introduction to Strings, Definition, Library Functions of Strings.	CO1, CO6
	Unit 2	**Stacks and Queues**	
	A	Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks	CO2, CO6
	B	Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.	CO2, CO6
	C	Representation of stacks & queues using linked, sequential and their applications.	CO2, CO6
	Unit 3	**Linked list sorting and searching**	
	A	Linked list, singly linked list, Circular linked list and doubly linked list, representation of linked list in memory	CO1,CO3, CO6
	B	Algorithms like insertion, deletion at beginning, middle and at the end of the linked list	CO1,CO3, CO6
	C	Various types of sorting like bubble sort, selection sort, insertion sort, quick sort, Merge Sort and searching like linear and binary search algorithms	CO1,CO3, CO6
	Unit 4	**Introduction to Trees**	

	A	Trees: Definition, Binary tree, Binary tree traversal: pre-order, in-order and post-order, Binary search tree.			CO4,CO5
	B	Binary search trees and operation like insertion deletion on binary search trees, AVL search trees with insertion deletion and rotation.			CO4,CO5
	C	M-way search trees, B-Trees and B+ Trees			CO4,CO5
	Unit 5	**Graphs**			
	A	Graphs: Definition and terminology, Representation of graphs and Types of Graphs.			CO4,CO5
	B	Traversing a graph: Breadth- First search, Depth first search and Implementation			CO4,CO5
	C	Minimum spanning trees by Prims Algorithms and Krushkal's Algorithm			CO4,CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	A Common-Sense Guide to Data Structures and Algorithms, Second Edition: Level Up Your Core Programming Skills 2nd Edition Data Structures Through C (A Practical Approach) Paperback – 1 January 2016 by G.S. Baluja			
	Other References	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication			

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	Apply the basic operations on arrays.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
2.	Construct complex programs like matrix implementations on arrays.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
3.	Apply the concept of stacks and queues in real life problem solving.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
4.	Apply the concepts of data structure, like linked list to solve complex problems.	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2
5.	Solving the real-life problems based on trees.	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2
6.	Implementing the graphs and apply graph concept in computer networks.	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2

PO and PSO mapping with level of strength for Course Name: Principal of Data Structures

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	1	1	1	-	-	2		-	1	1	1
CO2	2	2	2	1	-	-	2	-	-	1	1	2
CO3	2	2	2	1	-	-	2	-	-	1	2	2
CO4	2	1	2	3	2	-	2	-	-	1	1	1
CO5	2	2	3	2	2	-	2	-	-	1	2	2
CO6	3	3	3	2	2	-	2	-	-	1	2	2
Avg. PO attained	2.16	1.8	2.16	1.67	2		2			1	1.5	1.67

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**CMS132**	
2	Course Title	**Mathematical Expectations & Probability Distributions**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Minor	
5	Course Objective	Uncertainty is ubiquitous and probability theory provides a rational description of uncertainty. There is a growing realization that randomness is an essential component in the modeling and analysis of a variety of systems. Probability has become an important conceptual framework of computer science, engineering, and physical and biological sciences. Several problems in computer engineering and other disciplines arise, which require probabilistic modeling. The complete specification of the model enquires statistical tools for the analysis of data and inference	
6	Course Outcomes	CO1: Describe the basic concepts of probability and randomness with their applications. (K2, K5). CO2: Describe the properties of discrete and continuous random variables. (K2). CO3: Calculate the measures of central tendency and dispersion of data and describe the method used for analysis, including a discussion of advantages, disadvantages, and necessary assumptions. (K2, K3) CO4: Calculate and interpret the p robability distributions and their applications in real life; and limit theorems. (K2,K3). CO5: Monte Carlo simulation of simple probability models, entropy, and mutual information. (K2, K5) CO6: Develop the skills to interpret the results of statistical analysis. (K2, K5).	
7	Course Description	This is an introductory course in probability. Axioms of probability, conditional probability and independence, Bayes theorem, and probability distributions.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Mathematical Expectation**	
	A	Axioms of probability, conditional probability and independence, Bayes theorem,	CO1
	B	Random variables: discrete and continuous random variables, probability mass function (p.m.f), probability density function (p.d.f) and cumulative distribution function (c.d.f), Illustrations and properties of random variables.	CO1
	C	Mathematical Expectation: Expectation of single and bivariate random variables, properties of expectation, conditional expectation, and its properties. Moments and cumulants. Moment generating function, probability generating function.	CO1
	Unit 2	**Discrete Random Variable**	
	A	Random variables, distribution function, discrete random variable, expectation, variance	CO2
	B	Discrete distributions: Bernoulli and Binomial random variable, Poisson random variable, demerits	CO2
	C	Negative binomial random variable, Geometric random variable, and their properties, merits, and demerits	CO2
	Unit 3	**Continuous Random Variable**	
	A	Continuous random variable: the expectation of random variable, variance	CO3
	B	Continuous distributions: Uniform, Normal, Exponential, Gamma, and Cauchy, computing probabilities by conditioning, moment generating function, their properties, merits, and	CO3

		demerits.	
	C	Markov inequality and Chebyshev's inequality.	CO3
	Unit 4	**Jointly Distributed Random Variables**	CO4
	A	Jointly distributed random variables, Independent random variable, the sum of independent random variable	CO4, CO5
	B	Central Limit Theorem, conditional distribution with example.	CO4, CO5
	C	Joint probability distribution, covariance, correlation coefficient.	
	Unit 5	**Generation of Random Numbers**	
	A	Generation of random numbers and elements of Monte Carlo simulation.	CO5, CO6
	B	Elements of information theory: entropy as a measure of randomness.	CO5, CO6
	C	Exploratory data analysis, types of data, frequency tables, descriptive measures, variability measures	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	1. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2. Rohatgi, V.K. Introduction to Probability.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CMS132.1	3	3	2	2		1					1	1	1	
CMS132.2	2	3	3	2		1					1	1	1	
CMS132.3	2	2	2	3		1					1	1	1	
CMS132.4	2	3	2	2		1					1	1	1	
CMS132.5	3	3	2	2		1					1	1	1	
CMS132.6	3	3	2	3		1					1	1	1	
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**	**1.0**	

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**VAC110**	
2	Course Title	**Yoga for Holistic Health**	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	VAC	
5	Course Objective	To make the students familiar with the different practices of yoga, chanting and meditation techniques and learn the correct teaching skills.	
6	Course Outcomes	CO1: Recite the Vedic hymns given in traditional texts skillfully. CO2: Define the concept and principles of Yoga. CO3: Interpret and understand the loosening practices. CO4: Describe the knowledge about advance asanas. CO5: Make students aware of Yogic impact on the positive health and personality development. CO6: Learn primary level of Shatkarma, Pranayama & Dhyana	
7	Course Description		
8			
	Unit 1	**Yoga Philosophy in traditional texts**	
	A	Core Concepts of Hatha philosophy – Sapta Sadhana of Hatha Yoga	CO2, CO4, CO5, CO1
	B	Core concepts of Yoga darshana – Abhyasa Vairagya, Ishwara Pranidhana, Kriya Yoga, Ashtanga Yoga	CO1, CO2, CO4, CO5, CO6
	C	Core Concepts of Bhagawad Gita: Jnana Yoga, Dhyana Yoga, Karma Yoga, Bhakti Yoga	CO1, CO2, CO4, CO5, CO6
	Unit 2	**Yoga ahaara, Dinacharya, Ritucharya, Introduction to Yoga therapy, Pioneer institutes of research in Yoga**	
	A	Concept of Aahaara with relevance to modern lifestyle	CO3, CO4, CO5, CO6
	B	Dinacharya, Ritucharya in accordance with Swastha vritta	CO3, CO4, CO5, CO6
	C	Need for Yoga therapy, Pioneer Research Institutes in Yoga Therapy – Kaivalyadhama, SVYASA, Patanjali Yoga Peeth and their contributions in Yoga therapy	CO3, CO4, CO5, CO6
	Unit 3	**Sukshma Vyayama, Surya Namaskara, Kapalabhati**	
	A	Sukshma Vyayama and their health benefits (Bihar School of Yoga)	CO4, CO5, CO6
	B	Sukshma Vyayama and their health benefits (Swami Dhirendra Bramhachari)	CO4, CO5, CO6
	C	Surya Namaskara (Sun salutation) with mantra chanting (12 steps)	CO4, CO5, CO6
	Unit 4	**Advanced Asana - all categories**	
	A	Standing & Sitting - Trikonasana, Virabhadrasana I & II, Parvatasana, Yogamudrasana, Baddhakonasana,	CO4, CO5, CO6

		Ardhamastyendrasana, Navasanasa	
	B	Supine and Prone: Setubandhasana, Jatharaparivartitasana, Dhanurasana, Chakrasana	CO4, CO5, CO6
	C	Balancing and Inverted: Trivikramasana, Virabhadrasana – III, Halasana, Shirshasana	CO4, CO5, CO6
	Unit 5	**Shatkarma, Pranayama, Dhyana**	
	A	Shatkarma - Kapalabhati, Agnisara, Bindu Trataka	CO1, CO4, CO5, CO6
	B	Bhastrika, Shitali, Sheetkari, Bhramari	CO1, CO4, CO5, CO6
	C	Dhyana: Yoga Nidra, Nadanusandhana	CO1, CO4, CO5, CO6
	Mode of examination	Theory and Practical	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	Sri Ananda: The Complete book of Yoga, Orient Course Backs, Delhi,2003.	
	Other References	1. Basavaraddi, I.V. & others: SHATKARMA: A Comprehensive description about Cleansing Process, MDNIY New Delhi, 2009 2. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009 3. Dr. Nagendra H R: Pranayama, The Art & Science, Swami VivekanandaYoga Prakashan, Bangalore, 2005. 4. Swami Niranjananand: Asana Pranayama Mudra Bandha, Yoga Publication Trust, Munger Bihar. 5. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009 6. Swami Kuvalyananda: Pranayama, Kaivalyadhama, Lonavla, 2010 7. Swami Rama: Science of Breath, A Practical Guide, The HimalayanInternational Institute, Pennselvenia, 1998. 8. Swami Niranjananand Saraswati: Prana, Pranayama & Pranavidya, YogaPublications Trust, Munger, Bihar, 2005	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
VAC110.1			2			1	1		2	2	1			
VAC110.2			2			1	1		2	2	1			
VAC110.3			2			1	1		2	2	1			
VAC110.4			2			1	1		2	2	1			
VAC110.5			2			1	1		2	2	1			
VAC110.6			2			1	1		2	2	1			
Average			**2.0**			**1.0**	**1.0**		**2.0**	**2.0**	**1.0**			

School:		**SHARDA SCHOOL OF ENGINEERING & SCIENCE**				
Program:		**B.Sc. (Hons. /Hons. With Research)**				
Branch:		**Data Science & Analytics**				
Semester:		**II**				
1	**Course Code**	**MTP1251**				
2	**Course Title**	**Principal of Data Structures Lab**				
3	**Credits**	**1**				
4	**Contact Hours (L-T-P)**	**0-0-2**				
	Course Status	Compulsory				
5	Course Objective	To Develop arrays-based program to implement matrix To write program to implement stacks and queues Perform operation on various data structures like trees and graphs				
6	Course Outcomes	By the end of this course, the student will be able to: CO-1 Apply the basic operations on arrays (K2) CO-2 Construct complex programs like matrix implementations on arrays (K2) CO-3 Apply the concept of stacks and queues in real life problem solving (K3) CO-4. Apply the concepts of data structure, like linked list to solve complex problems (K4) CO-5. Solving the real-life problems based on trees (K5) CO-6 Implementing the graphs and apply graph concept in computer networks (K6)				
7	Course Description	An introduction design and implement data structures. Design and develop various program in lab like programs on stacks and queues, program on linked list like singly linked list and doubly linked list, program on trees and graphs.				
8	Outline syllabus				CO Mapping	
	Unit 1	Programs based on arrays				
		Write programs to implement the matrix operations			CO1, CO6	
	Unit 2	Programs based on stacks and queues				
		Programs to implement the stacks and queues operations			CO2, CO6	
	Unit 3	Programs based on linked list, searching and sorting				
		Programs to implement the linked list, searching and sorting			CO3, CO6	
	Unit 4	Programs based on Trees				
		Program to implement the trees like insertion, deletion of a node including tree traversal			CO4, CO6	
	Unit 5	Programs based on Graphs				
		Program to implement the graphs like Dijkstra algorithm, Prims algorithm and Kruskal's algorithm			CO5, CO6	
	Mode of examination	Jury/Practical/Viva				
	Weightage Distribution	CA	CE (Viva)	ESE		
		30%	30%	40%		
	Text book/s*	A Common-Sense Guide to Data Structures and Algorithms, Second Edition: Level Up Your Core Programming Skills 2nd Edition Data Structures Through C (A Practical Approach) Paperback – 1 January 2016 by G.S. Baluja				
	Other References	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI				

		Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publication		

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO) & Program Specific Outcomes (PSO)
1.	CO-1 Apply the basic operations on arrays (K2)	PO1, PO3, PO4, PO8, PO9, PO10, PSO1
2.	CO-2 Construct complex programs like matrix implementations on arrays (K2)	PO1, PO2, PO3, PO4, PO8, PO9, PO10
3.	CO-3 Apply the concept of stacks and queues in real life problem solving (K3)	PO1, PO2, PO3, PO4, PO8, PO9, PO10
4.	CO-4. Apply the concepts of data structure, like linked list to solve complex problems (K4)	PO1, PO2, PO3, PO4, PO8, PO9, PO10, PSO1
5	CO-5. Solving the real-life problems based on trees (K5)	PO1, PO2, PO3, PO4, PO8, PO9, PO10, PSO1
6	CO-6 Implementing the graphs and apply graph concept in computer networks (K6)	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PSO1

PO and PSO mapping with level of strength for Course Name Principal of Data Structures lab (BOL204)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	-	3	2	-	-	-	2	2	2	1	-
CO2	3	3	3	2	-	-	-	3	2	2	-	-
CO3	3	3	3	2	-	-	-	3	2	2	-	-
CO4	3	3	3	3	-	-	-	3	2	2	2	-
CO5	3	3	3	2	-	-	-	3	2	2	2	-
CO6	3	3	3	2	2	-	2	3	2	2	3	-

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2
Principal of Data Structures Lab	3	3	3	2.2	2	-	2	2.8	2	2	2	-

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**ARP102**	
2	Course Title	**Communicative English -2**	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
	Course Status	AEC	
5	Course Objective	To Develop LSRW skills through audio-visual language acquirement, creative writing, advanced speech et al and MTI Reduction with the aid of certain tools like texts, movies, and long and short essays.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Acquire Vision, Goals, and Strategies through Audio-visual Language Texts CO2: Synthesize complex concepts and present them in creative writing CO3:Develop MTI Reduction/Neutral Accent through Classroom Sessions & Practice CO4: Determine their role in achieving team success by defining strategies for effective communication with different people CO5: Realize their potential as human beings and conduct themselves properly in the ways of the world. CO6 Acquire satisfactory competency in the use of Quantitative aptitude and Logical Reasoning	
7	Course Description	The course takes the learnings from the previous semester to an advanced level of language learning and self-comprehension through the introduction of audio-visual aids as language enablers. It also leads learners to an advanced level of writing, reading, listening, and speaking abilities, while also reducing the usage of L1 to a minimum to increase employability chances.	
8			
	Unit 1	**Acquiring Vision, Goals, and Strategies through Audio-visual Language Texts**	
	A	Pursuit of Happiness / Goal Setting & Value Proposition in life	CO1
	B	12 Angry Men / Ethics & Principles	CO1
	C	The King's Speech / Mission statement in life | strategies & Action Plans in Life	CO1
	Unit 2	**Creative Writing**	CO2
	A	Story Reconstruction - Positive Thinking	CO2
	B	Theme-based Story Writing - Positive attitude	CO2
	C	Learning Diary Learning Log – Self-introspection	
	Unit 3	**Writing Skills 1**	CO3
	A	Precis	CO3
	B	Paraphrasing	CO3
	C	Essays (Simple essays)	
	Unit 4	**MTI Reduction/Neutral Accent through Classroom Sessions & Practice**	CO4
	A	Vowel, Consonant, sound correction, speech sounds, Monothongs, Diphthongs and Tripthongs	CO4
	B	Vowel Sound drills, Consonant Sound drills, Affricates and Fricative	CO4

		Sounds	
	C	Speech Sounds | Speech Music| Tone | Volume| Diction |Syntax |Intonation | Syllable Stress |	CO4
	Unit 5	**Gauging MTI Reduction Effectiveness through Free Speech**	
	A	Jam sessions	CO4
	B	Extempore	
	C	Situation-based Role Play	CO5
	Unit 6	**Leadership and Management Skills**	
	A	Innovative Leadership and Design Thinking	CO5
	B	Ethics and Integrity	CO5
	Unit 7	**Universal Human Values**	
	A	Love & Compassion, Non-Violence & Truth	CO5
	B	Righteousness, Peace	CO6
	C	Service, Renunciation (Sacrifice)	CO6
	Unit 8	**Introduction to Quantitative aptitude & Logical Reasoning**	
	A	Analytical Reasoning & Puzzle Solving	CO6
	B	Number Systems and its Application in Solving Problems	CO6
	Mode of examination	Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem-Solving Scenarios/GD/Simulations	
	Weightage Distribution	30% CA , 30% CE and 40% ETE	
	Text book/s*	Wren, P.C.&Martin H. High English Grammar and Composition, S.Chand& Company Ltd, New Delhi.	
	Other References	Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication Comfort, Jeremy(et.al). Speaking Effectively. Cambridge University Press. The Luncheon by W. Somerset Maugham - http://mistera.co.nf/files/sm_luncheon.pdf	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
ARP102.1	1	2	2	2		1	1	3	1					
ARP102.2	1	2	3	2		1	1	3	1					
ARP102.3	1	2	2	2		1	1	3	1					
ARP102.4	1	2	2	2		1	1	3	1					
ARP102.5	1	2	2	2		1	1	3	1					
ARP102.6	1	2	2	2		1	1	3	1					
Average	**1.0**	**2.0**	**2.0**	**2.0**		**1.0**	**1.0**	**3.0**	**1.0**					

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2025-26**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	**VOM104**	
2	Course Title	**Advanced Excel Skills for Business**	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	SEC	
5	Course Objective	1. To work through challenges that are all too common that we encounter every day. 2. To learn to confidently operate this Excel means adding a highly valuable asset to the employability portfolio.	
6	Course Outcomes	CO1: How to use functions like COUNTIFS to extract information from data, as well as generate graphical and table representations of it. CO2: Illustrate pivot tables and gain skills to create interactive dashboards with pivot charts and slicers. CO3: Apply data validation through conditional logic and conditional format. CO4: Analyze functions like CHOOSE, VLOOKUP, INDEX, MATCH, and other dynamic lookups to find and display data from several sources. CO5: Evaluate errors, trace precedents and dependents, and resolve circular references. CO6: Create protected worksheets and workbooks.	
7	Course Description	In offices throughout the world, spreadsheet software continues to be one of the most frequently used programs. A significant tool will be added to your employability profile after you learn to use this software with assurance. Every day, there are millions of job postings in India alone that mention having Excel abilities. Digital skills contribute to higher income and better employment chances.	
8			
	Unit 1	**Summarizing Data and Tables**	
	A	COUNT functions, Counting with Criteria (COUNTIFS), Adding with Criteria (SUMIFS), Sparklines, Advanced Charting, Trendlines.	CO1
	B	Creating and Formatting Tables, Working with Tables, Sorting and Filtering in Tables	CO1
	C	Automation with Tables, Converting to Range, and Subtotaling	CO1
	Unit 2	**Pivot Tables, Charts, and Slicers**	
	A	Creating and Modifying a Pivot Table	CO2
	B	Value Field Settings, Sorting and Filtering a Pivot Table	CO2
	C	Reporting Filter Pages, Pivoting Charts, Pivoting Slicers	CO2
	Unit 3	**Data Validation and Conditional Logic**	
	A	Data Validation, Creating Drop-down Lists, Using Formulas in Data Validation	CO3
	B	Working with Data Validation, Advanced Conditional Formatting	CO3
	C	Logical Functions I: IF, Logical Functions II: AND, OR, Combining Logical Functions I: IF, AND, OR, Combining Logical Functions II: Nested Ifs, Handling Errors: IFERROR, IFNA	CO3
	Unit 4	**Automating Lookups**	
	A	Introduction to Lookups: CHOOSE	CO4

	B	Approximate Matches: Range VLOOKUP, Exact Matches: Exact Match VLOOKUP	CO4
	C	Finding a Position: MATCH, Dynamic Lookups: INDEX, MATCH	CO4
	Unit 5	**Formula Auditing and Protection**	
	A	Error Checking, Formula Calculation Options, Trace Precedents and Dependents	CO5
	B	Evaluate Formula, Watch Window	CO5
	C	Protecting Workbooks and Worksheets	CO6
	Mode of examination	Practical Based	
	Weightage Distribution	CA, CE:30%; ESE: 40%	
	Text book/s*	1. Michael Alexander, Excel® Dashboards & Reports for Dummies, John Wiley & Sons, Inc, ISBN: 978-1-119-07676-6, 2016.	
	Other References	1. Michael Alexander and Dick Kusleika, Excel 2016 Formulas, John Wiley & Sons, Inc, ISBN: 978-1-119-06786-3, 2016.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
VOM104.1		2	1	2		1		3					1	1
VOM104.2		2	1	2		1		3					1	1
VOM104.3		2	1	2		1		3					1	1
VOM104.4		2	1	2		1		3					1	1
VOM104.5		2	1	2		1		3					1	1
VOM104.6		2	1	2		1		3					1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**					**1.0**	**1.0**

SEMESTER-III

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**BDA217**	
2	Course Title	**Data Preparation and Data Cleaning**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	CC	
5	Course Objective	To make students familiar with the concepts of preparing your data; Working with dates and times, Data Cleaning, Data Structure, and cleaning Text Data.	
6	Course Outcomes	CO1: Describe preparing data: Rearranging and removing variables, renaming variables, Variable classes, calculating new numeric variables, and explaining how to Dividing a continuous variable into categories, and working with factor variables. (K1, K3) CO2: Discuss how to work with dates and times, adding and removing observations and explain about removing duplicate observations, selecting a subset of the data, selecting a random sample from a dataset, and sorting a dataset. (K2, K3, K4) CO3: Explain the data cleaning and technical representation of data. (K2, K3, K4) CO4: Discuss the data structure. (K2, K6) CO5: Describe Character Normalization, Encoding Conversion and Unicode Normalization, Character Conversion, and Transliteration. (K1, K2) CO6: Discuss and evaluate Generating Regular Expressions in R, Common String Processing Tasks in R, Approximate Text Matching, String Metrics, String Metrics, and Approximate Text Matching in R.	
7	Course Description	This course introduces preparing your data; Working with dates and times, Data Cleaning, Data Structure, and cleaning Text Data.	
8			
	Unit 1		
	A	Preparing your data: Rearranging and removing variables, renaming variables, Variable classes, Calculating new numeric variables,	CO1
	B	Dividing a continuous variable into categories, Working with factor variables,	CO1
	C	Manipulating character variables: Concatenating character strings, extracting a substring, Searching a character variable.	CO1
	Unit 2		
	A	Working with dates and times, Adding and removing observations,	CO2
	B	Removing duplicate observations, Selecting a subset of the data,	CO2
	C	Selecting a random sample from a dataset, Sorting a dataset.	CO2
	Unit 3		

	A	Data Cleaning: The Statistical Value Chain, Raw Data, Input Data, Valid Data, Statistics, and Output.	CO3
	B	Technical Representation of Data: Numeric Data, Integers, Integers in R, Real Numbers, Double Precision Numbers, The Concept of Machine Precision, Consequences of Working with Floating Point Numbers, Dealing with the Consequences,	CO3
	C	Numeric Data in R, Text Data, Terminology and Encodings, Unicode, Textual Data in R: Objects of Class Character, Encoding in R, Reading, and Writing of Data with Non-Local Encoding, Detecting Encoding, Collation, and Sorting, Times and Dates. Time and Date Notation, Time and Date Storage in R, Time and Date Conversion in R, Leap Days, Time Zones, and Daylight-Saving Times.	CO3C
	Unit 4		
	A	Data Structure: Introduction, Tabular Data, data.frame, Databases, dplyr, Matrix Data, Time Series,	CO4
	B	Graph Data, Web Data, Web Scraping, Web API, Other Data, Tidying Tabular Data,	CO4
	C	Variable Per Column, Single Observation Stored in Multiple Tables.	CO4
	Unit 5		
	A	Cleaning Text Data: Character Normalization, Encoding Conversion and Unicode Normalization, Character Conversion and Transliteration,	CO5
	B	Pattern Matching with Regular, Expressions, Basic Regular Expressions, Practical Regular Expressions, Generating Regular Expressions in R,	CO5
	C	Common String Processing Tasks in R, Approximate Text Matching, String Metrics, String Metrics, and Approximate Text Matching in R.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE: 25%, ETE:75%	
	Text book/s*	1. Bad Data Handbook: Cleaning Up the Data So You Can Get Back to Work by Q. Ethan McCallum 2. Best Practices in Data Cleaning: A Complete Guide to Everything You Need to Do Before and After Collecting Your Data by Jason W Osborne	
	Other References	1. Data Wrangling with Python by Jacqueline Kazil 2. Principles of Data Wrangling: Practical Techniques for Data Preparation by Tye Rattenbury	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA217.1		2	1	2		1		3			2		1	1
BDA217.2		2	1	2		1		3			2		1	1
BDA217.3		2	1	2		1		3			2		1	1
BDA217.4		2	1	2		1		3			2		1	1
BDA217.5		2	1	2		1		3			2		1	1
BDA217.6		2	1	2		1		3			2		1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**2.0**		**1.0**	**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**BDA313**	
2	Course Title	**Regression, Time Series, Forecasting and Index Numbers**	
3	Credits	5	
4	Contact Hours (L-T-P)	5-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of the course is to explain basic concepts of regression, time series, forecasting and index numbers.	
6	Course Outcomes	CO1: Explain and illustrate the nature and uses of forecasts, some examples of time series, the forecasting process, resources for forecasting, statistics background for forecasting: graphical displays, numerical description of time series data (K2, K3) CO2: Describe how to evaluate least squares estimation in linear regression models, statistical inference in linear regression, prediction of new observations, model adequacy checking, model adequacy checking, generalized and weighted least squares, regression models for general time series data. (K6) CO3: Explain and illustrate first-order exponential smoothing, modeling time series data, second-order exponential smoothing, higher-order exponential smoothing. (K3, K6) CO4: Use forecasting: constant process, linear trend process and evaluate estimation of σ_e^2, adaptive updating of the discount factor, model assessment. (K3, K6) CO5: Describe autoregressive integrated moving average (arima) models. (K2) CO6: Explain and illustrate index numbers with application. (K6)	
7	Course Description	This course will cover the fundamental concepts of Regression, time series, forecasting and Index numbers.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Introduction to Forecasting: The Nature and Uses of Forecasts, Some Examples of Time Series, The Forecasting Process, Resources for Forecasting,	CO1
	B	Statistics Background for Forecasting: Graphical Displays, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments,	CO1
	C	General Approach to Time Series Modeling and Forecasting, Evaluating and Monitoring Forecasting Model Performance	CO1
	Unit 2		
	A	Regression Analysis and Forecasting: Least Squares Estimation in Linear Regression Models	CO2
	B	Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking	CO2
	C	Model Adequacy Checking, Generalized and Weighted Least Squares, Regression Models for General Time Series Data.	CO2
	Unit 3		
	A	Introduction of Time series, Utility of Time series, Components of time series, Models of time series, Methods of measuring linear trends, Methods of measuring seasonal variation, Method of measuring cyclic variation	CO3

	B	Exponential Smoothing Methods: First-Order Exponential Smoothing, Modeling Time Series Data, Second-Order Exponential Smoothing, Higher-Order Exponential Smoothing,	CO4
	C	Forecasting: Constant Process, Linear Trend Process, Estimation of σ_e^2, Adaptive Updating of the Discount Factor, Model Assessment.	CO4
	Unit 4		
	A	Autoregressive Integrated Moving Average (ARIMA) Models : Linear Models for Stationary Time Series, Stationary Time Series, 3 Finite Order Moving Average (MA) Processes.	CO5
	B	The First-Order Moving Average Process, MA(l), The Second-Order Moving Average Process, MA(2),Finite Order Autoregressive Processes,1 First -Order Autoregressive Process, AR(l), Second-Order Autoregressive Process, AR(2),	CO5
	C	General Autoregressive Process, AR(p), Partial Autocorrelation Function, PACF, Mixed Autoregressive-Moving Average CARMA) Processes, Time Series Model Building, Model Identification, Parameter Estimation, Examples of Building ARIMA Models, Forecasting ARIMA Processes.	CO5
	Unit 5		
	A	Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including	CO6
	B	Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers,	CO6
	C	Conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA, MTE: 25%, 25% / ETE: 50%	
	Text book/s*	1.Business Statistics: For Contemporary Decision Making, 7th Edition by Ken Black	
	Other References	1.Daniel,WayneW.,"Biostatistics": Basic concept and Methodology for Health Science. 2.Grewal,B.S, "Higher Engineering Mathematics".	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BDA313.1	3	3	2	2	2	3	2	2	2	2
BDA313.2	2	3	3	3	3	2	1	2	2	2
BDA313.3	2	3	2	2	2	2	2	2	2	2
BDA313.4	2	2	2	3	2	2	1	2	2	2
BDA313.5	3	2	2	3	2	2	2	2	2	3
BDA313.6	2	3	2	2	2	2	1	2	2	2

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**BDA215**	
2	Course Title	**Operations Research**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
0	Course Status	OPE	
5	Course Objective	1. To familiarize the students with basic concepts of optimization and classification of optimization problems. 2. To understand the basic concept of Formulation simplex methods variable with upper bounds.	
6	Course Outcomes	Students will be able to: CO1: Explain the fundamental knowledge of Linear Programming problem and Duality problems. (K1, K2, K3). CO2: Use classical optimization techniques and numerical methods of optimization. (K2, K3, K4). CO3: Describe the basics of different NLPP and KKT conditions. (k3, K4). CO4: Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas. (K2, K3, K4). CO5: Students will understand the concept of LPP and NLPP and will be able to solve some real-life problems using optimization techniques. (K3, K4, K5) CO6: Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems. (K4, K5, K6).	
7	Course Description	This course is an introduction to the basic understanding of with applications and scope of O.R. Formulation of linear programming problems and then different methods to solve them will be discussed. Duality in LPP will be introduced. An introduction to NLPP and some solving methods will be covered. At the end KKT Conditions, Unconstrained and constrained optimization techniques will be discussed.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction to LPP, Graphical Method, and Simplex Method**	
	A	Introduction to Optimization, Assumptions & Mathematical Modeling of LPP, Graphical Solution of L.P.P., Graphical Solution of LPP-I, Graphical Solution of LPP- II.	CO1
	B	Solution of L.P.P. by Simplex method, Revised Simplex Method, Introduction of Big M method, Algorithm of BIG-M method.	CO1
	C	Problems on BIG-M Method, Two Phase Method: Introduction and Two-Phase Method: Problem Solution.	CO1
	Unit 2	**Duality Theory and Integer Programming**	
	A	Special Cases of LPP, Degeneracy in LPP, Sensitivity Analysis- I, Sensitivity Analysis- II, and Problems on Sensitivity Analysis.	CO2
	B	Introduction to Duality Theory- I, Introduction to Duality Theory- II, Dual Simplex Method and Examples on Dual Simplex Method.	CO2
	C	Integer Linear Programming, IPP: Branch & B-Bound Method and Mixed Integer Programming Problem.	CO2
	Unit 3	**Introduction to transportation problem and Some Solving Methods**	

	A	Introduction to transportation problem-I, Transportation problem-II, Vogel Approximation method, optimal solution Generation for Transportation problem and Degeneracy in TP and problems.	CO3
	B	Introduction to Nonlinear Programming, Graphical Solution of NLP, and Types of NLP.	CO3
	C	One-dimensional unconstrained optimization, Region Elimination Technique-1, Region Elimination Technique-2, and Region Elimination Technique-3.	CO3
	Unit 4	**NLP and Unconstrained optimization**	
	A	Multivariate Unconstrained Optimization-1, Multivariate Unconstrained Optimization-2.	CO4
	B	NLP with Equality Constrained-1, NLP with Equality Constrained-2, Constrained NLP-1, and Constrained NLP 2.	CO4
	C	Constrained Optimization, Constrained Optimization, and KKT (Karush-Kuhn-Tucker conditions)	CO4
	Unit 5	**Constrained optimization and Dynamic programming of LPP**	
	A	Constrained Optimization, Constrained Optimization, and Feasible Direction.	CO5
	B	Penalty and barrier method, Penalty method, and Penalty and barrier method.	CO5
	C	Dynamic programming, Multi-Objective decision-making, and Multi-Attribute decision-making.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ETE:50%	
	Text book/s*	1. Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, Sultan Chand & Sons. 2. S. Chandra, Jayadeva, Aparna Mehra, Numerical Optimization with Applications, Narosa.	
	Other References	1 Hamdy A. Taha, Operations Research, An Introduction, 9th Edition, Pearson. 2. M.S. Bazarra, H.D. Sheral, and C.M. Shetty, Nonlinear Programming Theory and Algorithms.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA215.1	1	2	2	2	1	1	1	2	3		1			1
BDA215.2	1	2	3	2	1	1	1	2	3		1			1
BDA215.3	1	2	2	2	1	1	1	2	3		1			1
BDA215.4	1	2	3	3	1	1	1	2	3		1			1
BDA215.5	1	2	2	2	1	1	1	2	3		1			1
BDA215.6	1	2	2	2	1	1	1	2	3		1			1
Average	**1.0**	**2.0**	**2.3**	**2.1**	**1.0**	**1.0**	**1.0**	**2.0**	**3.0**		**1.0**			**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**DAP2351**	
2	Course Title	**Data Preparation and Data Cleaning Lab**	
3	Credits	2	
4	Contact Hours(L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	To make students familiar with the concepts of preparing your data; Working with dates and times, Data Cleaning, Data Structure, and Cleaning Text Data.	
6	Course Outcomes	CO1: Describe preparing data: Rearranging and removing variables, renaming variables, Variable classes, calculating new numeric variables, and explaining how to Dividing a continuous variable into categories, Working with factor variables. (K1, K3) CO2: Discuss how to work with dates and times, add and remove observations and explain about removing duplicate observations, selecting a subset of the data, selecting a random sample from a dataset, and sorting a dataset. (K2, K3, K4) CO3: Explain the data cleaning and technical representation of data. (K2, K3, K4) CO4: Discuss the data structure. (K2, K6) CO5: Describe Character Normalization, Encoding Conversion and Unicode Normalization, Character Conversion, and Transliteration. (K1, K2) CO6: Discuss and evaluate Generating Regular Expressions in R, Common String Processing Tasks in R, Approximate Text Matching, String Metrics, String Metrics, and Approximate Text Matching in R.	
7	Course Description	This course introduces preparing your data; Working with dates and times, Data Cleaning, Data Structure, and cleaning Text Data.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Lab. Experiment 1**	
	A, B, C	Problem Related to Data Collection and Potential Sources of Error	CO1, CO2
	Unit 2	**Lab. Experiment 2**	
	A, B, C	Problem-based on identifying, analyzing, and resolving data issues	CO2, CO3
	Unit 3	**Lab. Experiment 3**	
	A, B, C	Problem-based on handling missing data and ensuring the accuracy of record values	CO3, CO4
	Unit 4	**Lab. Experiment 4**	
	A, B, C	Problem-based on quality control procedure, and data Integration.	CO4, CO5
	Unit 5	**Lab. Experiment 5**	
	A, B, C	Problem-based on tools and techniques for data cleaning.	CO5, CO6
	Mode of examination	Practical + Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. Bad Data Handbook: Cleaning Up the Data So You Can Get Back to Work by Q. Ethan McCallum	

		2. Best Practices in Data Cleaning: A Complete Guide to Everything You Need to Do Before and After Collecting Your Data by Jason W Osborne	
	Other References	1. Data Wrangling with Python by Jacqueline Kazil 2. Principles of Data Wrangling: Practical Techniques for Data Preparation by Tye Rattenbury	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAP2351.1	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP2351.2	1	2	3	2	1	1	1	3	1	1	3	1	2	3
DAP2351.3	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP2351.4	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP2351.5	1	2	2	2	1	1	1	3	1	1	3	1	2	3
DAP2351.6	1	2	2	2	1	1	1	3	1	1	3	1	2	3
Average	**1.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	**1.0**	**3.0**	**1.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons./Hons. With Research) Mathematics		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**AI3407**	
2	Course Title	Prompt Engineering for AI and Data Science	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	DSE	
5	Course Objective	This course introduces the basics of AI prompting, including different types of prompts and how to structure them for better responses. Students will learn key techniques like providing context, refining prompts, and handling multi-turn conversations. The course also explores real-world applications in content creation, coding, and automated data analysis while addressing ethical considerations. By the end, students will be able to craft effective prompts and understand AI's role in various domains.	
6	Course Outcomes	**CO1**: Understand the basics of AI prompting and different types of prompts. **CO2**: Learn how to structure prompts effectively for better AI-generated responses. **CO3**: Apply advanced techniques like Chain-of-Thought prompting and multi-turn conversations. **CO4**: Explore real-world applications of AI prompting in content creation, coding, and automated data analysis. **CO5**: Identify ethical considerations and biases in AI-generated content. **CO6**: Develop the ability to craft optimized prompts for various industries and future AI trends.	
7	Course Description	This course provides a foundational understanding of AI prompting, teaching students how to effectively communicate with AI models to generate accurate and useful responses. It covers different types of prompts, key strategies for refining AI outputs, and advanced techniques like Chain-of-Thought prompting. Practical applications in content creation, coding, and business automation are explored, along with ethical considerations. By the end of the course, students will be able to craft effective prompts for various real-world scenarios.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Prompting**	
	A	What is prompting and understanding AI models (GPT, LLMs, Transformers)	CO1, CO2
	B	Types of prompts (Instructional, Open-ended, Role-based), Basic prompt structures	CO1, CO2
	C	Importance of effective prompts	CO1, CO2
	Case Study	**Using AI for Customer Support:** How well-structured vs. poorly structured prompts impact AI responses in customer service chatbots.	
	Unit 2	**Fundamentals of Effective Prompting**	
	A	Clarity and specificity in prompts, Role of context and	CO4

		constraints			
	B	Importance of examples in prompting			CO4
	C	Common mistakes in prompting			CO4
	Case Study	**AI in Content Writing:** How prompt refinement improves AI-generated articles, blog posts, and marketing copy.			
	Unit 3	**Advanced Prompting Techniques**			
	A	Chain-of-thought prompting (breaking down complex queries)			CO3
	B	Few-shot and zero-shot learning, Multi-turn conversation strategies			CO3
	C	Bias and ethical considerations in prompting, Prompt debugging techniques			CO3
	Case Study	**AI for Code Generation:** Comparing results of different prompts in generating Python/Java code using AI.			
	Unit 4	**Domain-Specific Prompting**			
	A	Prompting for different industries (Healthcare, Legal, Education, Marketing).			CO2
	B	AI-powered prompting to EDA, statistical queries, visualization, and report generation.			CO2
	C	Using AI for decision-making support, Fine-tuning AI responses for professional use.			CO2, CO5
	Case Study	**AI in Education:** How educators can use AI for generating lesson plans, quizzes, and explanations			
	Unit 5	**Real-World Applications & Future of Prompting**			
	A	AI-assisted research and writing			CO5
	B	Prompting in automation and AI agents, The role of prompt engineering in AI-driven products			CO5
	C	Future trends in AI prompting			CO6
	Case Study	***AI in Business Decision-Making:*** How companies use AI-generated insights for market analysis and strategic planning			
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
AI3407.1	3	3	2	2	2	3	2	2	1	1
AI3407.2	2	3	3	3	3	2	1	2	2	2
AI3407.3	2	3	2	1	2	2	2	1	2	2
AI3407.4	2	2	2	3	2	2	1	2	2	2
AI3407.5	3	2	2	3	2	2	2	2	2	1
AI3407.6	3	3	2	2	3	3	2	2	2	2
Average	**2.5**	**2.7**	**2.2**	**2.3**	**2.3**	**1.7**	**1.8**	**1.8**	**1.7**	**1.7**

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**VOM2305**	
2	Course Title	***Data Visualization with Tableau and Power BI***	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	SEC	
5	Course Objective	By the end of this course, students will be able to: 1. **Understand** the fundamentals of data visualization and BI tools. *(K1 – Remembering)* 2. **Apply** data connection and transformation techniques in Tableau & Power BI. *(K2 – Understanding, K3 – Applying)* 3. **Create** interactive dashboards and reports for business insights. *(K4 – Analyzing, K5 – Evaluating)* 4. **Compare** different visualization techniques for effective storytelling. *(K4 – Analyzing, K5 – Evaluating)* 5. **Design** and deploy real-time dashboards using Power BI & Tableau. *(K6 – Creating)*	
6	Course Outcomes	CO1: Explain BI concepts and tool functionalities. **(K1, K2)** CO2: Perform data preprocessing and cleaning. **(K2, K3)** CO3: Create interactive charts, reports, and dashboards (K3, K4) CO4: Analyze datasets to generate business insights (K4, K5) CO5: Design and publish BI reports professionally (K5, K6) CO6: Collaborate on BI projects using Tableau and Power BI to deliver data-driven solutions. (K5, K6)	
7	Course Description	This practical lab course introduces students to Business Intelligence (BI) using Tableau and Power BI. It covers data connection, cleaning, transformation, and advanced visualization techniques. Students will learn to analyze datasets, build interactive dashboards, and derive actionable insights. Emphasis is placed on real-world applications, storytelling, and report publishing. The course culminates with a hands-on project simulating a full BI workflow.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction to Tableau and Power BI**	
	A	Install & Setup Tableau Public & Power BI	CO1
	B	Connecting to CSV, Excel, and SQL databases	CO1
	C	Understanding Data Models, Joins, and Relationships, Creating Basic Bar, Line, and Pie Charts	CO1

	Unit 2	**Data Preprocessing & Transformation**	
	A	Handling missing values and data types, Data cleaning with Power Query	CO2
	B	Creating calculated columns & measures	CO2
	C	Using Filters, Slicers, and Groups	CO2
	Unit 3	**Advanced Visualizations & Dashboards**	
	A	Creating Time Series and Trend Analysis	CO3
	B	Implementing Heatmaps, Maps, and Scatter Plots	CO3
	C	KPI indicators and Conditional Formatting, Designing an Interactive Dashboard	CO3
	Unit 4	**Data Analysis & Storytelling**	CO4
	A	Analyzing Business Performance using BI	CO4
	B	Forecasting and Clustering in Power BI	CO4
	C	Case Study: Sales & Customer Analytics/ Creating a Storyboard for Business Insights	CO5
	Unit 5	**Report Publishing & Performance Optimization**	
	A	Publishing Reports to Tableau Public & Power BI Service	CO5
	B	Performance Optimization Techniques in BI	CO6
	C	Scheduling Data Refresh in Power BI, Final Project – Creating a Full Business Dashboard	CO6
	Mode of examination	Practical Based	
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*	1. Murray, D. (2016). *Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software*. Wiley. ISBN: 9781119001195.	
	Other References	1. Lachev, M. (2021). *Applied Microsoft Power BI (5th Edition): Bring your data to life!*. Prologika Press. ISBN: 9781733046127.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
VOM2305.1		2	1	2		1	2	3	2		2			1
VOM2305.2		2	1	2		1	2	3	2		2			1
VOM2305.3		2	1	2		1	2	3	2		2			1
VOM2305.4		2	1	2		1	2	3	2		2			1
VOM2305.5		2	1	2		1	2	3	2		2			1
VOM2305.6		2	1	2		1	2	3	2		2			1
Average		**2.0**	**1.0**	**2.0**		**1.0**	**2.0**	**3.0**	**2.0**		**2.0**			**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**DAR2351**	
2	Course Title	**Research Based Learning-1**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-2	
	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			
	Unit 1	**Introduction**	**CO1**
	Unit 2	**Case study**	**CO1,CO2**
	Unit 3	**Conceptual**	**CO2,CO3**
	Unit 4	**Development**	**CO3**
	Unit 5	**Finalisation**	**CO3,CO4**
	Mode of examination		
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*		

	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAR2351.1	3	3	2	2	1	1					2	1		
DAR2351.2	2	3	2	2	1	1					2	1		
DAR2351.3	2	2	2	3	1	1					2	1		
DAR2351.4	2	3	2	2	1	1					2	1		
DAR2351.5	3	3	2	2	1	1					2	1		
DAR2351.6	3	3	2	3	1	1					2	1		
Average	**2.3**	**2.6**	**2.0**	**2.1**	**1.0**	**1.0**					**2.0**	**1.0**		

SEMESTER – IV

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA202**	
2	Course Title	**Database Management Systems**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	To make students familiar with the basic concepts of Databases and Transactions and Data Models, Database Design, ER-Diagram and Unified Modeling Language, Relational Algebra and Calculus, Constraints, Views and SQL, Transaction management, and Concurrency control.	
6	Course Outcomes	CO1: Discuss the basics of Databases and Transactions and Data Models. (K1, K2, K3) CO2: Discuss about Database Design, ER-Diagram, and Unified Modeling Language. (K1, K3) CO3: Explain relational algebra and calculus, describe Domain relational Calculus, calculus vs algebra, and computational capabilities. (K3, K4) CO4: Explain and illustrate Constraints, Views, and SQL. (K3, K6) CO5: Evaluate different types of transaction management. (K4, K5) CO6: Explain concurrency control, time stamping methods, optimistic methods, and database recovery management. (K2, K4, K5)	
7	Course Description	This course introduces the basic concepts of Databases and Transactions and Data Models, Database Design, ER-Diagram and Unified Modeling Language, Relational Algebra and Calculus, Constraints, Views and SQL, Transaction management, and Concurrency control.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction to Databases and Transactions and Data Models**	
	A	What is a database system, purpose of the database system, what view of data, relational databases, database architecture.	CO1
	B	Transaction management, The importance of data models, Basic building blocks,	CO1
	C	Business rules, The evolution of data models, Degrees of data abstraction.	CO1
	Unit 2	**Database Design, ER-Diagram, and Unified Modeling Language**	
	A	Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas,	CO2
	B	Introduction to UML Relational database model: Logical view of data, keys, integrity rules.	CO2
	C	Relational Database design: features of good relational database design, atomic domain, and Normalization (1NF, 2NF, 3NF, BCNF).	CO2
	Unit 3	**Relational Algebra and Calculus**	
	A	Relational algebra: introduction, Selection, and projection, set operations, renaming, Joins, Division, syntax, semantics.	CO3
	B	Operators, grouping and ungrouping, relational comparison.	CO3
	C	Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	CO3

	Unit 4	**Constraints, Views, and SQL**	
	A	What are constraints, types of constraints, and Integrity constraints?	CO4
	B	Views: Introduction to views, data independence, security, updates on views, and comparison between tables.	CO4
	C	Views SQL: data definition, aggregate function, Null Values, nested subqueries, Joined relations. Triggers.	CO4
	Unit 5	**Transaction management and Concurrency control**	
	A	Transaction management: ACID properties, serializability, and concurrency control,	CO5, CO6
	B	Lock-based concurrency control (2PL, Deadlocks), Time stamping methods.	CO5, CO6
	C	Optimistic methods, database recovery management.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1."Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill	
	Other References	1 "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer science Press. 2 "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
BDA202.1	3	3	2	2		1					1	1		
BDA202.2	2	3	3	2		1					1	1		
BDA202.3	2	2	2	3		1					1	1		
BDA202.4	2	3	2	2		1					1	1		
BDA202.5	3	3	2	2		1					1	1		
BDA202.6	3	3	2	3		1					1	1		
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**		

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA214**	
2	Course Title	**Sampling Theory**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	To make students familiar with the concept of sample and population, complete enumeration versus sampling. The concept of Systematic Sampling, estimates of the population mean and total, variances of these estimates along with the brief of the present official statistical system in India, methods of collection of official statistics, their reliability, and limitations have been introduced.	
6	Course Outcomes	CO1: Explain and illustrate the concepts of sample and population. (K2, K3, K4) CO2: Describe the properties of complete enumeration versus sampling; explain random sampling with and without replacement. (K1, K2, K3) CO3: Describe estimates of the population mean, explain its application and estimates of these variances, and sample size determination. (K2, K3, K4) CO4: Describe stratified random sampling, estimates of the population mean and total and explain its application, and illustrate systematic sampling. (K2, K3, K4) CO5: Describe the ratio and regression methods of estimation and evaluate variances in terms of the correlation coefficient between X and Y for the regression method and their comparison with SRS. (K2, K3, K6) CO6: Describe and analyze the basic concepts present official statistical system in India, and methods of collection of official statistics. (K1, K2, K4)	
7	Course Description	This course initiates the advanced concept of sample and population, complete enumeration versus sampling. The concept of Systematic Sampling, estimates of the population mean and total, variances of these estimates along with the brief of the present official statistical system in India, methods of collection of official statistics, their reliability, and limitations have been introduced.	
8			
	Unit 1		
	A	Concept of sample and population, complete enumeration versus sampling	CO1
	B	Sampling and non-sampling errors, requirements of a good sample,	CO1
	C	Simple random sampling with and without replacement.	CO2
	Unit 2		
	A	Estimates of the population mean, total, and proportion,	CO3
	B	Variances of these estimates	CO3
	C	Estimates of theses variances and sample size determination.	CO3
	Unit 3		
	A	Stratified random sampling, estimates of the population mean, and total variances of these estimates.	CO4
	B	Proportional and optimum allocations and their comparison with SRS.	CO4

	C	Systematic Sampling, estimates of the population mean and total, variances of these estimates.	CO4
	Unit 4		
	A	Ratio and regression methods of estimation, estimates of the population mean and total (for SRS of large size),	CO5
	B	Variances of these estimates and estimates of theses variances,	CO5
	C	Variances in terms of the correlation coefficient between X and Y for regression method and their comparison with SRS.	CO5
	Unit 5		
	A	Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations.	CO6
	B	Principal publications containing data on the topics such as population, industry, and finance.	CO6
	C	Various official agencies are responsible for data collection and their main functions.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta 2. Cochran W.G (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.	
	Other References	1. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall 2. Guide to Current Indian Official Statistics, Central Statistical Organization, GOI, New Delhi.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA214.1	3	3	2	2		1					1	1	1	
BDA214.2	2	3	3	2		1					1	1	1	
BDA214.3	2	2	2	3		1					1	1	1	
BDA214.4	2	3	2	2		1					1	1	1	
BDA214.5	3	3	2	2		1					1	1	1	
BDA214.6	3	3	2	3		1					1	1	1	
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**	**1.0**	

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA323**	
2	Course Title	**Multivariate Data Analysis**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	CC	
5	Course Objective	Familiarise students with the multivariate normal distribution, estimation of the mean vector and the covariance matrix, the distributions and uses of sample correlation coefficients, classification of observations, the distribution of the sample covariance matrix, and the sample generalized variance.	
6	Course Outcomes	CO1: Demonstrate knowledge and understanding of the multivariate normal distribution. (K2, K3) CO2: Demonstrate knowledge and understanding of the concept of estimation of the mean vector and the covariance matrix. (K2, K3) CO3: Demonstrate advanced understanding of the concepts of dimension reduction technique. (K2, K3) CO4: Describe the concepts of how to use and apply dependence techniques in multivariate data analysis. (K2, K3) CO5: Describe the concepts of analysis of variance and covariance in multivariate data analysis. (K3, K4, K5) CO6: Apply the statistical tool and software in multivariate data analysis. (K2, K6)	
7	Course Description	This module aims to provide an understanding of the multivariate normal distribution, estimation of the mean vector and the covariance matrix, the distributions and uses of sample correlation coefficients, classification of observations, the distribution of the sample covariance matrix, and the sample generalized variance.	
8			
	Unit 1		
	A	A brief review of Univariate and Bivariate distribution with their properties.	CO1
	B	Basic Multivariate Distribution: mean, variance, Covariance, correlation, and the linear combination of variables.	CO1
	C	The multivariate normal distribution, Mean Vectors, and Covariance Matrices.	CO1
	Unit 2		
	A	Multivariate normal distribution; maximum likelihood estimation, Wishart's distribution	CO2
	B	Hotelling's T2 and hypothesis testing for multivariate normal data. Inference from a single sample, Inference from two dependent samples Inference from two independent samples.	CO2
	C	Simple, Multiple, Partial, and Canonical correlations with their properties.	CO2
	Unit 3		
	A	Principal Components Analysis and derivation of principal components; PCA structural model; PCA on normal populations; bi-plots.	CO3
	B	Factor Analysis, Factor extraction Factor rotation, Factor scores Validation of factor analysis, Higher order factor analysis Q-type factor analysis	CO3, CO4

	C	Cluster Analysis, Types of clustering, Correlation, and distance, Partitioning methods, hierarchical clustering, K-means clustering, and their interpretation.	CO4
	Unit 4		
	A	Simple, Multiple, and Multivariate regression with their properties.	CO5
	B	Binary and multidimensional Logistic regression.	CO5
	C	Linear discriminant function analysis. Estimating linear discriminant functions and their properties.	CO5
	Unit 5		
	A	Analysis of variance and covariance.	CO6
	B	Multivariate analysis of variance and Covariance.	CO6
	C	Concepts of correspondence analysis, chi-square distance and inertia, multiple correspondence analysis.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1. Johnson, R.A. and Wichern, D.W.: Applied Multivariate Statistical Analysis, Sixth Edition, Pearson Education India. 2. Hardle, W.K. and Hlavka, Z. Multivariate Statistics, Springer.	
	Other References	1. Anderson, T.W.: An Introduction to Multivariate Statistical Analysis, Third Edition, Wiley. 2. Härdle, W.K. and Simar, L. : Applied Multivariate Statistical Analysis, Springer.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA323.1	3	3	2	2	2	1					2	2		
BDA323.2	2	3	3	2	2	1					2	2		
BDA323.3	2	2	2	3	2	1					2	2		
BDA323.4	2	3	2	2	2	1					2	2		
BDA323.5	3	3	2	2	2	1					2	2		
BDA323.6	3	3	2	3	2	1					2	2		
Average	**2.3**	**2.6**	**2.0**	**2.1**	**2.0**	**1.0**					**2.0**	**2.0**		

School: SSES		**Batch: 2023-27**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**DAP2452**	
2	Course Title	**Sampling Theory Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	This course initiates the advanced concept of sample and population, complete enumeration versus sampling. The concept of Systematic Sampling, estimates of the population mean and total, variances of these estimates along with the brief of the present official statistical system in India, methods of collection of official statistics, their reliability, and limitations have been introduced.	
6	Course Outcomes	CO1: Explain and illustrate the concepts of sample and population. (K2, K3, K4) CO2: Describe the properties of complete enumeration versus sampling; explain random sampling with and without replacement. (K1, K2, K3) CO3: Describe estimates of the population mean, explain its application and estimates of these variances, and sample size determination. (K2, K3, K4) CO4: Describe stratified random sampling, estimates of the population mean and total and explain its application, and illustrate systematic sampling. (K2, K3, K4). CO5: Describe the ratio and regression methods of estimation and evaluate variances in terms of the correlation coefficient between X and Y for the regression method and their comparison with SRS. (K2, K3, K6). CO6: Describe and analyze the basic concepts present official statistical system in India, and methods of collection of official statistics. (K1,K2, K4).	
7	Course Description	This is an advanced course in statistics. Students are introduced to the f concepts involved in using sample data to make inferences about populations. Included are the study of measures of central tendency and dispersion, finite probability, statistical inferences from large and small samples, linear regression, and correlation and hypothesis.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Lab. Experiment 1**	
	A, B, C	Problem based on how to draw the sample from the population in SRSWR and SRSWOR and PPS sampling	CO1, CO2
	Unit 2	**Lab. Experiment 2**	
	A, B, C	Problem-based on simple random sampling and find that SRSWOR performs better than SRSWR and PPS sampling	CO1, CO3
	Unit 3	**Lab. Experiment 3**	
	A, B, C	Problem-based on stratified random sampling and applications of allocation techniques	CO1, CO4
	Unit 4	**Lab. Experiment 4**	
	A, B, C	Problem-based on systematic sampling and circular systematic sampling	CO1, CO5
	Unit 5	**Lab. Experiment 5**	
	A, B, C	Problem-based on ratio, difference and regression type estimator.	CO1, CO6
	Mode of examination	Practical+Viva	102
	Weightage	CA:30%; CE:30%; ESE:40%	

	Distribution		
	Text book/s*	1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta 2. Cochran W.G (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.	
	Other References	1. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall 2. Guide to current Indian Official Statistics, Central Statistical Organization, GOI, New Delhi.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAP2452.1	1	2	2	2	1	1	1	3	1		2	1		
DAP2452.2	1	2	3	2	1	1	1	3	1		2	1		
DAP2452.3	1	2	2	2	1	1	1	3	1		2	1		
DAP2452.4	1	2	2	2	1	1	1	3	1		2	1		
DAP2452.5	1	2	2	2	1	1	1	3	1		2	1		
DAP2452.6	1	2	2	2	1	1	1	3	1		2	1		
Average	**1.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**		**2.0**	**1.0**		

Programme: B.Sc.(Hons./Hons. With Research)		**Academic Year: 2026-27**		
Branch: Data Science & Analytics		**Semester: IV**		
1	Course Code	**AI3408**		
2	Course Title	Supervised & Unsupervised Learning Techniques		
3	Credits	3		
4	Contact Hours (L-T-P)	0-0-6		
	Course Status	Minor		
5	Course Objective	This course aims to introduce students to the fundamentals of data science by exploring both supervised and unsupervised learning techniques. It provides hands-on experience in data preprocessing, feature engineering, model training, evaluation, and optimization using Python. Students will develop programming and analytical skills, apply key mathematical concepts such as linear algebra, probability, and optimization, and gain insights into building effective machine learning models for real-world data science applications.		
6	Course Outcomes	**CO1**: Apply data preprocessing techniques to real-world datasets for exploratory data analysis and model readiness. **CO2**: Implement and evaluate supervised and unsupervised learning models. **CO3**: Analyze model performance using various evaluation metrics. **CO4**: Optimize models using hyperparameter tuning techniques. **CO5**: Understand advanced supervised and unsupervised learning techniques for structured/tabular data **CO6**: Develop problem-solving skills using machine learning techniques in various domains.		
7	Course Description	This lab course covers the basics of supervised and unsupervised learning. Students will learn how to apply machine learning algorithms using Python. The lab focuses on hands-on experience with data preprocessing, model training, evaluation, and optimization, helping students understand machine learning concepts and solve real-world problems.		
8	Outline syllabus			CO Mapping
	Unit 1	**Introduction to Machine Learning**		
	A	Introduction to Python Libraries: NumPy, Pandas, Matplotlib, and Scikit-learn.		CO1
	B	Data Preprocessing Techniques: Handling missing values, feature scaling, and encoding categorical variables.		CO1
	C	Exploratory Data Analysis (EDA): Visualizing and understanding datasets using statistical methods.		CO2

	Unit 2	**Supervised Learning Techniques**			
	A	Implementing Linear Regression: Predicting house prices using a dataset.			CO2
	B	Logistic Regression: Classification of spam emails			CO2
	C	Decision Trees, Random Forest, Support Vector Machines (SVM).			CO3
	Unit 3	**Unsupervised Learning Techniques**			
	A	K-Means Clustering: Customer segmentation in retail data.			CO2
	B	Hierarchical Clustering: Clustering gene expression data.			CO3
	C	Principal Component Analysis (PCA): Dimensionality reduction of high-dimensional data.			CO4
	Unit 4	**Model Evaluation and Optimization**			
	A	Cross-validation and Model Performance Metrics: Accuracy, Precision, Recall, F1-score.			CO4
	B	Hyperparameter Tuning: Grid Search and Randomized Search.			CO4
	C	Bias-Variance Tradeoff: Understanding overfitting and underfitting in mode			CO5
	Unit 5	**Applications of Supervised and Unsupervised Learning in Real-World Scenarios**			
	A	Predictive analytics (e.g., stock price prediction, weather forecasting etc).			CO5
	B	Healthcare applications (e.g., disease classification, medical diagnosis, etc).			CO6
	C	Fraud detection in banking (e.g., credit card fraud detection). Case study discussions on ethical AI and bias in ML models.			CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
AI3408.1	2	1	2	2	1	2	3	2	2	2	2	2	2	2
AI3408.2	2	1	2	2	1	2	3	2	2	2	2	2	2	2
AI3408.3	2	1	2	2	1	2	3	2	2	2	2	2	2	2
AI3408.4	2	1	2	2	1	2	3	2	2	2	2	2	2	2
AI3408.5	2	1	2	2	1	2	3	2	2	2	2	2	2	2
AI3408.6	2	1	2	2	1	2	3	2	2	2	2	2	2	2
Average	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

<table>
<tr><td colspan="2">School: SSES</td><td colspan="2">Batch: 2025-29</td></tr>
<tr><td colspan="2">Program: B.Sc. (Hons. / Hons. With Research)</td><td colspan="2">Academic Year: 2026-27</td></tr>
<tr><td colspan="2">Branch: Data Science & Analytics</td><td colspan="2">Semester: IV</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="2">CCU108</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="2">Community Connect</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="2">2 Course Status: Training/Survey/Project</td></tr>
<tr><td>4</td><td>(L-T-P)</td><td colspan="2">(0-0-4)</td></tr>
<tr><td>5</td><td>Learning Hours</td><td colspan="2"><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>6</td><td>Course Objectives</td><td colspan="2">1. Contribute to the holistic development of students by making them more aware of socially and economically disadvantaged communities and their specific issues
2. Provide richer context to classrooms, to make them more effective laboratories of learning by aligning them to social realities beyond textbooks
3. Provide scope to faculty members to align their teaching and research goals by giving them ample opportunity to carry out community-oriented projects
4. Ensure that the community connect programs provides benefits to communities in tangible ways so that they may feel perceptibly better off post the interaction and involvement of the Sharda academic community
5. Provide ample opportunity for Sharda University academic community to contribute effectively to society and nation building</td></tr>
<tr><td>7</td><td>Course Outcomes</td><td colspan="2">After completion of this course, students will be able to:
CO1: Students learn to be sensitive to the living challenges of disadvantaged communities.
CO2: Students learn to appreciate societal realities beyond textbooks and classrooms
CO3: Students learn to apply their knowledge via research, and training for community benefit
CO4: Students learn to work on socio-economic projects with teamwork and timely delivery
CO5: Students learn to engage with communities for meaningful contributions to society.
CO6: The survey will help to identify the gaps and create a plan to further improve</td></tr>
</table>

		the situation related to social problems prevailing in different sections of society and find the solution in a sustainable manner.
8	**Theme**	**Major research themes:** 1. ***Survey and self-learning***: In this mode, students will make the 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, the need for treatment, use of renewable (mainly solar) energy, electricity-saving devices, inefficiencies in the cropping system, 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 Program, BetiBachao, BetiPadhao 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.
9.1	**<u>Guidelines for Faculty Members</u>**	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. **A plagiarism check of the report must**.

		ETE will conduct out of 100, divided in three parts (i) 30 Marks for the report (ii) 30 Marks for the presentation (iii) 40 Marks for knowledge. The student should **submit the report** to CCC-Coordinator signed by the faculty guide by …… The students have to send the hard copy of the **report and PPT**, and then only they will be allowed for ETE.
9.2	**Role of CCC-Coordinator**	The CCC Coordinator will supervise the whole process and assign students to faculty members. 1. UG- B.Sc.-Semester VI - the students will be allocated to faculty member (mentors/faculty member) in odd term.
9.3	**Layout of the Report**	Abstract (250 words) a. Introduction b. Literature review(optional) c. Objective of the research d. Research Methodology e. Finding and discussion f. Conclusion and recommendation g. References,Note: Research report should base on primary data.
9.4	**Guideline for Report Writing**	**Title Page: The following elements must be included:** • Title of the article; • Name(s) and initial(s) of 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**.
9.5	**Format:**	**The report should be Spiral/ hardbound** The Design of the Cover page to report will be given by the Coordinator- CCC Cover page, Acknowledgement, Content, Project report,Appendices
9.6	**Important Dates:**	Students should prepare questionnaire and get it approved by concern faculty member and submit the final questionnaire within …….to CCC-Coordinator. Students will complete their survey work within …….. and submit the same to concern faculty member. (Each group should complete 50 questionnaires) The student should show the 1st draft of the report to concern faculty member within …….. and submit the same to concern faculty member. Faculty members should give required inputs, so that students can improve their project work and make the final report submission on …….. The students should submit the hard copy and soft copy of the report to CCC-Coordinator signed by the faculty guide within ……. **The students should submit the soft copy of the PPT to CCC-Coordinator signed by the faculty guide within** ……. **The final presentation will be organized on ……...**
9.7	**ETE**	**The students will be evaluated by panel of faculty members on the basis of their presentation on ……**

10	**Course Evaluation:30%**	
10.01	**Continuous Assessment**	**30%**
	Questionnaire design	
	Report Writing	
10.02	**ESE (PPT presentation)**	**40%**

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CCU108.1	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.2	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.3	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.4	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.5	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.6	1	2	2	3	3	2	3	3	3	2	1	2	2	3
Average	**1.0**	**2.0**	**2.0**	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**	**2.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**DAR2452**	
2	Course Title	**Research Based Learning-2**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Project (Audit-Qualifying)	
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 data science 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 data analytics and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.	
8			
	Unit 1	**Introduction**	**CO1**
	Unit 2	**Case study**	**CO1,CO2**
	Unit 3	**Conceptual**	**CO2,CO3**
	Unit 4	**Development**	**CO3**
	Unit 5	**Finalisation**	**CO3,CO4**
	Mode of examination		
	Weightage Distribution	CA, CE,=30%, ESE=40%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAR2452.1	3	3	2	2	1	1					1	1		
DAR2452.2	2	3	3	2	1	1					1	1		
DAR2452.3	2	2	2	3	1	1					1	1		
DAR2452.4	2	3	2	2	1	1					1	1		
DAR2452.5	3	3	2	2	1	1					1	1		
DAR2452.6	3	3	2	3	1	1					1	1		
Average	**2.3**	**2.6**	**2.0**	**2.1**	**1.0**	**1.0**					**1.0**	**1.0**		

SEMESTER-V

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA303**	
2	Course Title	**Machine learning**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	The objective of this course is to introduce machine learning fundamentals to students.	
6	Course Outcomes	CO1: Recognize the characteristics of machine learning that make it useful to real-world problems (K2, K3) CO2: Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised (K2, K3) CO3: Design and implement machine learning solutions to classification, regression, and clustering problems (K3, K6). CO4: Be able to evaluate and interpret the results of the algorithms (K4, K5) CO5: Effectively use machine learning toolboxes (K5). CO6: Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques. Ability to integrate deep learning libraries and mathematical and statistical tools (K4, K5).	
7	Course Description	This course provides introductory concepts of various machine learning techniques to students which will help to build the foundation for further understanding. This course also aims to provide details of various steps involved in the machine learning pipeline such as data collection, pre-processing, feature engineering, etc. This course also introduces popular tools used in the area of machine learning. This course mainly focused on Regression and Neural network-based Machine learning algorithms.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction to Machine Learning**	
	A	Machine Learning Fundamentals –Types of Machine Learning - Supervised, Unsupervised, Reinforcement- The Machine Learning process.	CO1
	B	Terminologies in ML- Testing ML algorithms: Over fitting, Training, Testing and Validation Sets-Confusion matrix -Accuracy metrics-ROC Curve.	CO1
	C	Basic Statistics: Averages, Variance and Covariance, The Gaussian-The Bias-Variance trade off- Applications of Machine Learning.	CO1
	Unit 2		
	A	Regression: Linear Regression – Multivariate Regression analysis, Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression	CO2
	B	Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier.	CO2
	C	Decision Tree based methods for classification and Regression-	CO2

		Ensemble methods.	
	Unit 3		
	A	Clustering- K-Means clustering, Hierarchical clustering.	CO3
	B	The Curse of Dimensionality –Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis	CO3
	C	The Internet, Business and Retail, Law Enforcement, Computing, Clustering models: How the K-means and PCA works, Calculating the number of clusters in a dataset.	CO3
	Unit 4		
	A	Perceptron- Multilayer perceptron- Back Propagation- Initialization, Training and Validation Support.	CO4
	B	Vector Machines (SVM) as a linear and non-linear classifier - Limitations of SVM	CO4
	C	Recognition of MNIST handwritten digits using Artificial Neural Network. Build an email spam classifier using SVM.	CO4
	Unit 5		
	A	Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models.	CO5
	B	Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning.	CO5
	C	Classify the given text segment as 'Positive' or 'Negative' statement using the Naive Bayes Classifier. Predict future stock price of a company using Monte Carlo Simulation.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE=25%, ESE:50%	
	Text book/s*	1. Mitchell Tom, Machine Learning. McGraw Hill. 2. Dr. Nilesh Shelke, Dr. Gopal Sakarkar, Dr N V Choudhari, Introduction to Machine Learning, Ganu Prakashan.	
	Other References	1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction 2. Andreas C. Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA303.1	3	3	2	2		1					3	3		
BDA303.2	2	3	3	2		1					3	3		
BDA303.3	2	2	2	3		1					3	3		
BDA303.4	2	3	2	2		1					3	3		
BDA303.5	3	3	2	2		1					3	3		
BDA303.6	3	3	2	3		1					3	3		
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**3.0**	**3.0**		

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA322**	
2	Course Title	**Statistical Simulation**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	The learning objectives include: Concept of simulation and simulation modeling, Generation of Pseudo random number generators as well as from standard statistical distributions, Monte-Carlo simulation technique and application of simulation techniques.	
6	Course Outcomes	CO1: Recognize the concepts of probability and statistics that are relevant to modeling and simulation (K2, K3). CO2: How to generate random numbers by the different methods (K2, K3). CO3: Design and implement Bootstrapping; jackknife resampling(K3, K4). CO4: Be able to evaluate and interpret the Markov-Chain Monte Carlo (MCMC) simulations (K3, K4). CO5: Hands-on experience in using simulation software packages/structured programming languages (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 (K4, K6).	
7	Course Description	The course topics will include a review of concepts from probability and statistics that are relevant to modeling and simulation, algorithms for random-variable sampling, modeling and analysis of basic queueing systems, variance-reduction techniques, statistical-validation techniques, Independent Monte Carlo (IMC) and Markov-Chain Monte Carlo (MCMC) simulations, and discrete-event modeling and simulation.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Review of R/Python.	CO1
	B	Random number generation: Inverse-transform; acceptance-rejection; transformations.	CO1
	C	Statistic simulations: generating random variables, simulating normal, gamma and beta random variables.	CO1
	Unit 2		
	A	Simulating multivariate distributions, MCMC methods.	CO2
	B	Gibbs sampler, simulating random fields, simulating stochastic process.	CO2
	C	Variance reduction technique: importance sampling for integration, control variates and antithetic variables.	CO2
	Unit 3		
	A	Bootstrapping; jackknife resampling.	CO3

	B	Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation.	CO3
	C	Bootstrapping in regression and sampling from finite populations.	CO3
	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	CO5, CO6
	B	Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization.	CO5, CO6
	C	EM (Expectation-Maximization) algorithm; simplex algorithm.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA,MTE:25%; ETE:50%	
	Text book/s*	1. Fishman, G.S. Monte Carlo: Concepts, Algorithms and Applications. 2. Rubinstein, R.Y.: Simulation and the Monte Carlo Method.	
	Other References	1. Ross, S. M.: Simulation, Third Edition, Academic Press. 2. Efron, B. and Tibshirani. R.J.: An introduction to the Bootstrap.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
BDA322.1	3	3	2	2	2	1					2	2		
BDA322.2	2	3	3	2	2	1					2	2		
BDA322.3	2	2	2	3	2	1					2	2		
BDA322.4	2	3	2	2	2	1					2	2		
BDA322.5	3	3	2	2	2	1					2	2		
BDA322.6	3	3	2	3	2	1					2	2		
Average	**2.3**	**2.6**	**2.0**	**2.1**	**2.0**	**1.0**					**2.0**	**2.0**		

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-2**	
Branch: Data Science & Analytics		**Semester: VI**	
1	**Course Code**	**BDA318**	
2	**Course Title**	**Data Visualization**	
3	**Credits**	**4**	
4	**Contact Hours (L-T-P)**	**4-0-0**	
	Course Status	**Compulsory (CC)**	
5	**Course Objective**	**Familiarise students with basic concepts of data visualization. Give an idea of data- analytic thinking, storytelling with data, data visualization using tableau 1. Given an understanding of a decision analytic thinking, fitting a model to data. Discuss the concept of visualizing model performance, data visualization using tableau 2, similarity, neighbors, and clusters.**	
6	**Course Outcomes**	**CO1: Explain the concept of data-analytic thinking. (K2, K4) CO2: Discuss the concept of data understanding; data preparation; modelling; evaluation; deployment. Analytic techniques and technologies. (K3) CO3: Explain the use of storytelling with data and support vector machines, decision trees.(K2, K3, K4) CO4: Explain the data visualization using tableau 1 and decision analytic thinking. (K2, K4,K5) CO5: Describe the fitting a model to data and visualizing model performance. (K1, K2, K4) CO6: Explain and evaluate data visualization using tableau 2 and similarity, neighbors, and clusters. (K2, K6)**	
7	**Course Description**	**This course will cover the basic concepts of data visualization. Give an idea of data- analytic thinking, storytelling with data, data visualization using tableau 1. Given an understanding of a decision analytic thinking, fitting a model to data. Discuss the concept of visualizing model performance, data visualization using tableau 2, similarity, neighbors, and clusters**	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	**Data-Analytic Thinking: The Ubiquity of Data Opportunities, Data Processing and "Big Data" From Big Data 1.0 to Big Data 2.0,**	**CO1, CO2**
	B	**Data and Data Science Capability as a Strategic Asset. From Business Problems to Data Mining Tasks: Business Understanding**	**CO1, CO2**
	C	**Data Understanding; Data Preparation; Modeling; Evaluation; Deployment. Analytic techniques and technologies.**	**CO1, CO2**
	Unit 2		
	A	**Story Telling with Data: Importance of context ; Choosing an effective visual ; Focus audience's attention ;Thinking like designer ;**	**CO3**
	B	**Dissecting model visuals; Lessons in story telling; Putting it all together; Case studies.**	**CO3**

	C	**Introduction to Predictive Modeling: Linear Regression; Classification: Logistic, Regression, Support Vector Machines, Decision Trees.**	**CO3**
	Unit 3		
	A	**Data Visualization Using Tableau 1: Introduction to Tableau; Data Import and Management: Data import, Extract and live , Data**	**CO4**

		management – Join, Data management – Relationship, Data Management – Replace; Data Type and Operation: Data type, Pivot and separate , Change type, Set and group, Hierarchy.		
	B	**Decision Analytic Thinking: Targeting the Best Prospects for a Charity Mailing -The Expected Value Framework: Decomposing the Business Problem and Recomposing the Solution Pieces , A Brief Digression on Selection Bias;**		**CO4**
	C	**Churn Example Revisited with Even More Sophistication - The Expected Value Framework: Structuring a More Complicated Business Problem, Assessing the Influence of the Incentive; From an Expected Value Decomposition to a Data Science Solution.**		**CO4**
	Unit 4			
	A	**Fitting a Model to Data: What is a good model? -Overfitting , Generalization Evaluating Classifiers , Plain Accuracy and Its Problems , Confusion Matrix , Problems with Unbalanced Classes, Problems with Unequal Costs and Benefits ;**		**CO5**
	B	**Generalizing Beyond Classification - Using Expected Value to Frame Classifier Evaluation; Evaluation, Baseline Performance, and Implications for Investments in Data.**		**CO5**
	C	**Visualizing Model Performance: Ranking Instead of Classifying; Profit Curves; ROC Graphs and Curves; The Area Under the ROC Curve (AUC); Cumulative Response and Lift Curves; Example: Performance Analytics for Churn Modeling.**		**CO5**
	Unit 5			
	A	**Data Visualization Using Tableau 2: *f* Different types of data visualizations - Visual encoding , Bar chart and pie chart , Line chart ,Multiple chart and distribution , Highlight tables , Scatter plot and trend lines, Heat map, Geographic mapping ,Bullet graph , Gnatt chart , Data calendar , Circle view.**		**CO6**
	B	**Similarity, Neighbors, and Clusters: Similarity and Distance; Nearest-Neighbor Reasoning o Example: Whiskey Analytics, How Many Neighbors and How Much Influence? , Issues with Nearest-Neighbor Methods;**		**CO6**
	C	**Clustering - Hierarchical clustering Example: Whiskey Analytics, Nearest Neighbors Revisited: Clustering Around Centroids; Example: Clustering Business News Stories - Understanding the Results of Clustering; Stepping Back: Solving a Business Problem Versus Data Exploration.**		**CO6**
	Mode of examination	**Theory**		
	Weightage Distribution	**CA, MTE**	**ETE**	
		25%	**50%**	

	Text book/s*	1. **Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few** 2. **Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsky**	
	Other References	1. **The Accidental Analyst: Show Your Data Who's Boss" by Eileen and Stephen McDaniel**	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
BDA318.1	3	3	2	2	2	1					2	2		
BDA318.2	2	3	3	2	2	1					2	2		
BDA318.3	2	2	2	3	2	1					2	2		
BDA318.4	2	3	2	2	2	1					2	2		
BDA318.5	3	3	2	2	2	1					2	2		
BDA318.6	3	3	2	3	2	1					2	2		
Average	**2.3**	**2.6**	**2.0**	**2.1**	**2.0**	**1.0**					**2.0**	**2.0**		

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA216**	
2	Course Title	**Statistical Inference**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	To introduce concepts of statistical analysis of descriptive statistics, logic, and analytical tools, analyze and communicate quantitative data verbally, graphically, symbolically, and numerically. To make students familiar with the concept of Probability and Statistics and hypothesis.	
6	Course Outcomes	CO1: Describe the process of statistical analysis of descriptive statistics, the principle of least square, lines of regression, simple linear regression, and evaluate multiple linear regression, coefficient of multiple determination. (K2, K5) CO2: Describe the process of fitting polynomials and exponential curves. (K2) CO3: Explain the criteria for obtaining a good estimator. (K2, K3) CO4: Calculate and interpret the point estimation, confidence interval, and construction of confidence intervals using a pivotal, shortest expected length confidence interval. (K2, K3) CO5: Understand the null hypothesis, alternative hypothesis, type I error, type II error, level of significance, p-value, and power of the test, and develop the ability to use a one-sample t-test, two-sample t-test, and paired-sample t-test. Variance tests based on normal distribution one-sample and two-sample problems. (K2, K5) CO6: Develop the skills to interpret the results of statistical analysis by using the Z-test, F-test, and chi-square test for goodness of fit. One-way and Two-way analysis of variance (ANOVA) techniques. (K2, K5)	
7	Course Description	This is an advanced course in statistics. Students are introduced to the f concepts involved in using sample data to make inferences about populations. Included are the study of measures of central tendency and dispersion, finite probability, statistical inferences from large and small samples, linear regression, and correlation and hypothesis.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		CO1
	A	Statistical analysis of descriptive statistics, the principle of least square, lines of regression, simple linear regression	CO1
	B	Coefficient of determination. Multiple linear regression, coefficient of multiple determination.	CO2
	C	Fitting of polynomials and exponential curves.	
	Unit 2		CO3
	A	Criteria for obtaining a good estimator: unbiasedness, consistency, efficiency, and sufficiency.	CO3
	B	Minimal sufficient statistic.	CO3
	C	Uniformly minimum variance unbiased estimator, complete statistic.	
	Unit 3		CO4

	A	Method of point estimation: Method of moments, maximum likelihood estimator, and its properties mean square error (MSE).	CO4
	B	Method of minimum chi-square, method of moments, Least square and their properties.	CO4
	C	Interval estimation: Confidence interval, construction of confidence intervals	
	Unit 4		CO5
	A	Null hypothesis, alternative hypothesis, type I error, type II error, level of significance, p-value, and power of the test.	CO5
	B	Tests for mean based on normal distribution- one-sample t-test, two-sample t-test, paired-sample t-test.	CO5
	C	Tests for variance based on normal distribution- one-sample and two-sample problem	
	Unit 5		CO6
	A	The large sample size test: Z-test, F-test, and Chi-square test for goodness of fit.	CO6
	B	One-way and Two-way analysis of variance (ANOVA) techniques.	CO6
	C	Statistical analysis of descriptive statistics, the principle of least square, lines of regression, simple linear regression	CO1
	Mode of examination	Theory	
	Weightage Distribution	CA, MTE:25%; ESE:50%	
	Text book/s*	1. Gupta, S.C. and Kapoor, V.K., "Fundamental of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2. Goon, A.M., Gupta, A.K. & Das Gupta. Fundamental of Statistics.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
BDA216.1	3	3	2	2		1					1	1	1	1
BDA216.2	2	3	3	2		1					1	1	1	1
BDA216.3	2	2	2	3		1					1	1	1	1
BDA216.4	2	3	2	2		1					1	1	1	1
BDA216.5	3	3	2	2		1					1	1	1	1
BDA216.6	3	3	2	3		1					1	1	1	1
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**	**1.0**	**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAP3551**	
2	Course Title	**Machine Learning Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	1. Learn the basic concepts of Machine Learning algorithms. 2. Make use of Data sets in implementing the machine learning algorithms. Implement the machine learning concepts and algorithms in any suitable language of choice.	
6	Course Outcomes	CO1: Show the implementation of linear and logistic Regression on real life applications. CO2: Interpretation of existing models to understand the solution environment. CO3: Application of existing mathematical solutions to test real world problems. CO4: Analyse the logical ability to apply clustering approach to extract hierarchical patterns existing in real life problems. CO5: Build the understanding of learning theory to glance the upcoming world through it. CO6: Appraise recent trends in machine learning and applications	
7	Course Description	This course introduces computational learning paradigm for critical & implementable understanding for supervised and unsupervised learning based problem areas.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		CO1
	A, B, C	Write a Program to load and view data set file. Perform exploratory data analysis (EDA) on a dataset using Python	CO1, CO6
		Write a program to implement simple linear regression using housing price prediction problem.	
		Write a program to implement binary logistic regression using cancer identification problem.	
	Unit 2		
	A, B, C	Write a program to implement gradient descent method for learning.	CO1, CO2
		Implement stochastic gradient descent (SGD) for large datasets.	
		Write a program to implement regularized linear regression.	
	Unit 3		
	A, B, C	Write a program to implement Support Vector Machine regression using suitable dataset. Implement XGBoost and LightGBM for classification and regression tasks.	CO1, CO2, CO6
		Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	
		Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	124

	Unit 4		
	A, B, C	Write a program to implement K-Means clustering algorithm using an appropriate dataset.	CO2, CO3, CO4
		Write a program to implement K-Means clustering algorithm using an appropriate dataset	
	Unit 5		
	A, B, C	Write a program to implement data split into training, cross validation and testing data.	CO4, CO5, CO6
		Implement an Ensemble approach by combining different models to solve time series based prediction problem.	
		Conduct hypothesis testing using some statistical toolkit on appropriate problem.	
	Mode of examination	Practical+Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. Bishop, C.: Pattern Recognition and Machine Learning. Berlin: Springer-Verlag. 2. Ethem Alpaydin: Introduction to Machine Learning, 3rd Edition	
	Other References	1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press. 2. https://www.toptal.com/machine-learning/ensemble-methodsmachine-learning.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAP3551.1	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.2	1	2	3	2	2	1	1	3	1	2	3	2	2	3
DAP3551.3	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.4	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.5	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.6	1	2	2	2	2	1	1	3	1	2	3	2	2	3
Average	**1.0**	**2.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**3.0**	**1.0**	**2.0**	**3.0**	**2.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAP3552**	
2	Course Title	**Statistical Simulation Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	The learning objectives include: Concept of simulation and simulation modeling, Generation of Pseudo random number generators as well as from standard statistical distributions, Monte-Carlo simulation technique and application of simulation techniques.	
6	Course Outcomes	CO1: Recognize the concepts of probability and statistics that are relevant to modeling and simulation (K2, K3). CO2: How to generate random numbers by the different methods (K2, K3). CO3: Design and implement Bootstrapping; jackknife resampling (K3, K4). CO4: Be able to evaluate and interpret the Markov-Chain Monte Carlo (MCMC) simulations (K3, K4). CO5: Hands-on experience in using simulation software packages/structured programming languages (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 (K4, K6).	
7	Course Description	The course topics will include a review of concepts from probability and statistics that are relevant to modeling and simulation, algorithms for random-variable sampling, modeling and analysis of basic queueing systems, variance-reduction techniques, statistical-validation techniques, Independent Monte Carlo (IMC) and Markov-Chain Monte Carlo (MCMC) simulations, and discrete-event modeling and simulation.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Lab. Experiment 1**	
	A, B, C	Review of R/Python.	CO1
		Problem Based on Random number generation: Inverse-transform; acceptance-rejection; transformations.	CO1
		Problem Based on Statistic simulations: generating random variables, simulating normal, gamma and beta random variables.	CO1
	Unit 2	**Lab. Experiment 2**	
	A, B, C	Problem Based on Simulating multivariate distributions, MCMC methods.	CO2
		Problem Based on Gibbs sampler, simulating random fields, simulating stochastic process.	CO2
		Problem Based on Variance reduction technique: importance sampling for integration, control variates and antithetic variables.	CO2
	Unit 3	**Lab. Experiment 2**	
	A, B, C	Problem Based on Bootstrapping; jackknife resampling.	CO3
		Problem Based on Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation.	CO3

		Problem Based on Bootstrapping in regression and sampling from finite populations.	CO3
	Unit 4	**Lab. Experiment 2**	
	A, B, C	Problem Based on Simulating a non-homogeneous Poisson process.	CO4
		Problem Based on Optimization using Monte Carlo methods simulated annealing for optimization.	CO4
		Problem Based on Solving differential equations by Monte Carlo methods.	CO4
	Unit 5	**Lab. Experiment 2**	
	A, B, C	Problem Based on Univariate density estimation; kernel smoothing multivariate density estimation	CO5, CO6
		Problem Based on Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization.	CO5, CO6
		Problem Based on EM (Expectation-Maximization) algorithm; simplex algorithm.	CO5, CO6
	Mode of examination	Practical+Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1.Fishman, G.S. Monte Carlo: Concepts, Algorithms and Applications. 2.Rubinstein, R.Y.: Simulation and the Monte Carlo Method.	
	Other References	1. Ross, S. M.: Simulation, Third Edition, Academic Press. 2. Efron, B. and Tibshirani. R.J.: An introduction to the Bootstrap.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAP3552.1	1	2	2	2		1	1	3	1		3	1	2	3
DAP3552.2	1	2	3	2		1	1	3	1		3	1	2	3
DAP3552.3	1	2	2	2		1	1	3	1		3	1	2	3
DAP3552.4	1	2	2	2		1	1	3	1		3	1	2	3
DAP3552.5	1	2	2	2		1	1	3	1		3	1	2	3
DAP3552.6	1	2	2	2		1	1	3	1		3	1	2	3
Average	**1.0**	**2.0**	**2.0**	**2.0**		**1.0**	**1.0**	**3.0**	**1.0**		**3.0**	**1.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons.)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAR3551**	
2	Course Title	**Research Based Learning-3**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-0	
	Course Status	Project	
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			
	Unit 1	**Introduction**	**CO1**
	Unit 2	**Case study**	**CO1,CO2**
	Unit 3	**Conceptual**	**CO3, CO4**
	Unit 4	**Development**	**CO4, CO5**
	Unit 5	**Finalisation**	**CO5, CO6**
	Mode of examination		
	Weightage Distribution	CA, CE=30%, ESE:40%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAR3551.1		2	1	2	2	1		3			2	2	2	2
DAR3551.2		2	1	2	2	1		3			2	2	2	2
DAR3551.3		2	1	2	2	1		3			2	2	2	2
DAR3551.4		2	1	2	2	1		3			2	2	2	2
DAR3551.5		2	1	2	2	1		3			2	2	2	2
DAR3551.6		2	1	2	2	1		3			2	2	2	2
Average		**2.0**	**1.0**	**2.0**	**2.0**	**1.0**		**3.0**			**2.0**	**2.0**	**2.0**	**2.0**

SEMESTER-VI

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA321**	
2	Course Title	**Non-Parametric Statistical Inference**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	Familiarise students with basic concepts of non parametric inference, nonparametric estimation, order statistics use and application in real life data.	
6	Course Outcomes	CO1: Explain the concept of non parametric inference. (K2, K4) CO2: Apply the concept of nonparametric estimation and explain completeness of the order statistic. (K3) CO3: Explain and use different non parametric test estimators. (K2, K3, K4) CO4: Explain properties of non parametric test estimators.(K2, K4) CO5: Describe the concept of order statistics. (K1, K2) CO6: Understand and evaluate the application of non parametric inference on real life data. (K2, K6)	
7	Course Description	This course will cover the basic concepts of non parametric inference, nonparametric estimation, order statistics use and application in real life data	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Non Parametric methods, Advantages and Disadvantages,	CO1
	B	Uses and application of non parametric method,	CO1
	C	Type of non parametric test,	CO1
	Unit 2		
	A	The sign test for paired data, One sample sign test,	CO2
	B	Ranked sum test, Manwhitney U test,	CO2
	C	Kruskalwali's test or H test,	CO2
	Unit 3		
	A	One sample run test, median test for randomness,	CO3
	B	Runs above and below the median, spearman rank correlation test	CO3, CO4
	C	Testing of hypothesis about rank correlation,	CO4
	Unit 4		
	A	Kolmogrov Smirnov test, Kendall test of Concordance	CO5
	B	Median test for two independent samples,	CO5
	C	Wilcoxon Signed rank test, The Matched pairs sign, test	CO5

	Unit 5			
	A	Introduction and application of order statistics, Distribution of Single Order Statistics,		CO6
	B	Joint distribution of two or more order statistics, Distribution of difference of two distinct order statistics.		CO6
	C	Distribution of Range, Distribution of Quartile and Distribution of median.		CO6
	Mode of examination	Theory		
	Weightage Distribution	CA, MTE	ETE	
		25%	50%	
	Text book/s*	1. Gibbons, J.D. & Chakraborti, S. (2010). Nonparametric Statistical Inference, 5th Edition. CRC Press. 2. Hollander, M., Wolfe, D. & Chicken, E. (2013). Nonparametric Statistical Methods, 3rd Edition. Wiley.		
	Other References	1. Bonnini, S., Corain, L., Marozzi, M. & Salmaso, L. (2014). Nonparametric Hypothesis Testing Rank and Permutation Methods with Applications in R. Wiley. 2. Sprent, P. & Smeeton, N.C. (2013). Applied Nonparametric Statistical Methods, 4th Edition. CRC Press.		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BDA321.1	3	3	2	2	2	3	2	2	1	1
BDA321.2	2	3	3	3	3	2	1	2	2	2
BDA321.3	2	3	2	1	2	2	2	1	2	2
BDA321.4	2	2	2	3	2	2	1	2	2	2
BDA321.5	3	2	2	3	2	2	2	2	2	1
BDA321.6	3	3	2	2	3	3	2	2	2	2

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA218**	
2	Course Title	**Data Ware Housing & Data Mining**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Minor	
5	Course Objective	Familiarise students with basic concepts of data warehousing, business analysis, data mining, association rule mining and classification, clustering, and trends in data mining.	
6	Course Outcomes	CO1: Discuss the Data warehousing Components, Cleanup, and transformation Tools - Metadata. (K3, K5) CO2: Explain methods of business analysis, reporting, and query tools and applications. (K2, K3, K4) CO3: Describe the OLAP guideline multidimensional versus multi relational OLAP, categories of tools, OLAP tools, and the internet. (K2, K4) CO4: Explain and illustrate data mining functionalities, the interestingness of patterns, integration of a data mining system with data warehouse issues, and data preprocessing. (K2, K3) CO5: Explain the basic concepts of decision tree induction, bayesian classification, rule-based classification, classification by backpropagation and apply support vector machines, associative classification, lazy learners, other classification methods, and prediction. (K2, K3, K4) CO6: Explain and evaluate clustering and trends in data mining. (K2, K4, K6)	
7	Course Description	This course introduces the basic concepts of data warehousing, business analysis, data mining, association rule mining and classification, clustering, and trends in data mining.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Data Warehousing**	
	A	Data warehousing Components –Building a Data warehouse.	CO1
	B	Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support	CO1
	C	Data Extraction, Cleanup, and Transformation Tools - Metadata.	CO1
	Unit 2	**Business Analysis**	CO2, CO3
	A	Reporting and Query tools and Applications, Cognos Impromptu, Online Analytical Processing (OLAP).	CO3
	B	Multidimensional Data Model, OLAP Guideline Multidimensional versus Multirotational OLAP,	CO3
	C	Categories of Tools, OLAP Tools, and the Internet.	
	Unit 3	**Data Mining**	CO4
	A	Introduction, Data, Types of Data, Data Mining Functionalities,	CO4
	B	Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives,	CO4
	C	Integration of a Data Mining System with Data Warehouse Issues, Data Preprocessing	

	Unit 4	**Association Rule Mining and Classification**	CO5
	A	Mining Frequent Patterns, Associations and Correlations, Mining Methods, Mining various Kinds of Association Rules, Correlation Analysis,	CO5
	B	Constraint-Based Association Mining Classification and Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation,	CO5
	C	Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, and Prediction.	
	Unit 5	**Clustering and Trends in Data Mining**	CO6
	A	Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-means, Partitioning Methods, Hierarchical Methods,	CO6
	B	Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High Dimensional Data, Constraint, Based Cluster Analysis, and Outlier Analysis.	CO6
	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.	
	Mode of examination	Theory	
	Weightage Distribution	CA, MTE:25%; ESE:50%	
	Text book/s*	1. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw Hill 2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier.	
	Other References	1. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining", Person Education. 2. K.P. Soman, Shyam Diwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA218.1	3	3	2	2		1					1	1		
BDA218.2	2	3	3	2		1					1	1		
BDA218.3	2	2	2	3		1					1	1		
BDA218.4	2	3	2	2		1					1	1		
BDA218.5	3	3	2	2		1					1	1		
BDA218.6	3	3	2	3		1					1	1		
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**		

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA325**	
2	Course Title	**Deep Learning**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	DSE	
5	Course Objective	The objective of this course is to provide advance knowledge of Deep learning techniques and also apply Deep learning Techniques to various engineering and social applications.	
6	Course Outcomes	CO1: Ability to identify the deep learning techniques (K2, K3). CO2: Ability to select and implement Machine learning and deep learning (K2,K3,K4) CO3: Ability to Train machine and solve problems associated with batch learning and online learning (K2, K3, K4). CO4: Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques(K3, K4,K5). CO5: Ability to integrate deep learning libraries and mathematical and statistical tools(K4, K5). CO6: Ability to apply Deep learning Techniques to various engineering and social applications(K4, K6).	
7	Course Description	This course mainly focused on Regression and Neural network based Machine learning algorithms. This aim to make students aware of various recent developments in the field of Neural network such as deep learning.	
8			
	Unit 1		
	A	History of Deep Learning, McCulloch Pitts Neuron.	CO1
	B	Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.	CO1
	C	Feed Forward Neural Networks, Back propagation.	CO1
	Unit 2		
	A	Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD.	CO2
	B	Principal Component Analysis and its interpretations, Singular Value Decomposition.	CO2
	C	Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders.	CO2
	Unit 3		
	A	Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Data set augmentation.	CO3
	B	Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.	CO3
	C	Learning Vectorial Representations Of Words.	CO3
	Unit 4		

	A	Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.	CO4
	B	Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs.	CO4
	C	Encoder Decoder Models, Attention Mechanism, Attention over images.	CO4
	Unit 5		
	A	Advanced Deep architectures: Recurrent Neural networks (RNNs), Generative Adversarial Networks (GANs).	CO5, CO6
	B	In-depth discussion of DL examples.	CO5, CO6
	C	Advanced topics, Recent papers, Influential papers: Visual Question Answering, Visual Dialog, Novel deep methods (Deep internal learning, Deep image prior).	CO5, CO6
	Mode of examination	Practical Based	
	Weightage Distribution	CA:25%; MTE:25%, ESE:50%	
	Text book/s*	1. Mahmoud Hassaballah, Ali Ismail Awad: Deep Learning in Computer Vision, Principles and Applications. 2. Dr.P.S. Jagadeesh Kumar, Prof. Thomas Binford, Dr. J. Ruby, J. Lepika. Modern Deep Learning and Advanced Computer Vision, A Perspective Approach.	
	Other References	1. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning Adaptive Computation and Machine Learning series", MIT Press. 2. Li Deng and Dong Yu "Deep Learning Methods and Applications", Foundations and Trends in Signal Processing.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA325.1		2	1	2		1		3			3	3		
BDA325.2		2	1	2		1		3			3	3		
BDA325.3		2	1	2		1		3			3	3		
BDA325.4		2	1	2		1		3			3	3		
BDA325.5		2	1	2		1		3			3	3		
BDA325.6		2	1	2		1		3			3	3		
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**3.0**	**3.0**		

School: SSES		**Batch: 2023-27**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA270**	
2	Course Title	**Data Ware Housing & Data Mining Lab**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	CC	
5	Course Objective	1. To introduce students to basic applications, concepts, and techniques of data mining. 2. To develop skills for using recent data mining software (eg. R) to solve practical problems in a variety of disciplines. 3. To gain experience doing independent study and research	
6	Course Outcomes	CO1: Learn how to build a data warehouse and query it (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics). (K2, K5) CO2: Learn to perform data mining tasks using a data mining toolkit (such as open source WEKA). (K2) CO3: Understand the data sets and data preprocessing. (K2, K3) CO4: Demonstrate the working of algorithms for data mining tasks such association rule mining, classification, clustering and regression. (K2, K3) CO5: Exercise the data mining techniques with varied input values for different parameters. (K2, K5) CO6: To obtain Practical Experience Working with all real data sets. (K2, K5)	
7	Course Description	To introduce students to basic applications, concepts, and techniques of data mining. To develop skills for using recent data mining software to solve practical problems in a variety of disciplines. To gain experience doing independent study and research	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Lab. Experiment 1**	
	A, B, C	Installation of WEKA Tool Creating new Arff File	CO1
	Unit 2	**Lab. Experiment 2**	
	A, B, C	Pre-Processes Techniques on Data Set Pre-process a given dataset based on Handling Missing Values	CO2
	Unit 3	**Lab. Experiment 3**	
	A, B, C	Generate Association Rules using the Apriori Algorithm Generating association rules using fp growth algorithm	CO3
	Unit 4	**Lab. Experiment 4**	
	A, B, C	Build a Decision Tree by using J48 algorithm Naïve bayes classification on a given data set	CO4
	Unit 5	**Lab. Experiment 5**	
	A, B, C	Applying k-means clustering on a given data set. Calculating Information gains measurs OLAP Cube and its different operations	CO5, CO6
	Mode of examination	Practical+Viva	
	Weightage	CA:30%; CE:30%; ESE:40%	

	Distribution		
	Text book/s*	1.Jiawei Han and M Kamber , Data Mining Concepts and Techniques, , Second Edition, Elsevier Publication.	
	Other References	1. Arun K. Pujari, Data Mining Techniques, University Press. 2. Vipin Kumar, Introduction to Data Mining Pang Ning Tan, Michael Steinbach, Addison Wesley.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BDA270.1	1	2	2	2	2	1	1	3	1	1	2	1	2	2
BDA270.2	1	2	3	2	2	1	1	3	1	1	2	1	2	2
BDA270.3	1	2	2	2	2	1	1	3	1	1	2	1	2	2
BDA270.4	1	2	2	2	2	1	1	3	1	1	2	1	2	2
BDA270.5	1	2	2	2	2	1	1	3	1	1	2	1	2	2
BDA270.6	1	2	2	2	2	1	1	3	1	1	2	1	2	2
Average	**1.0**	**2.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**3.0**	**1.0**	**1.0**	**2.0**	**1.0**	**2.0**	**2.0**

School: SSES		**Batch: 2025-29**		
Programme: B.Sc. (Hons./Hons. With Research)		**Academic Year: 2027-28**		
Branch: Data Science & Analytics		**Semester: VI**		
1	Course Code	**AI3409**		
2	Course Title	Advanced Machine Learning Techniques		
3	Credits	4		
4	Contact Hours (L-T-P)	0-0-8		
	Course Status	Minor		
5	Course Objective	To provide students with a strong understanding of **advanced machine learning** and its applications in **data science** through hands-on practice. The course covers **reinforcement learning, neural networks, and deep learning models** while incorporating essential **mathematical concepts** such as **probability, linear algebra, and optimization.** Students will explore techniques like **feature engineering, model evaluation, and hyperparameter tuning** to enhance **machine learning model performance** and apply them to real-world **data science challenges.**		
6	Course Outcomes	**CO1:** Understand and apply reinforcement learning techniques for data driven decision-making problems. **CO2:** Explain the structure of neural networks and train simple models using backpropagation **CO3:** Develop deep learning models using Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). **CO4:** Perform feature engineering techniques to enhance model performance in structured/tabular data analysis **CO5:** Evaluate machine learning models using appropriate metrics and techniques. **CO6**: Interpret machine learning models and analyze ethical concerns related to AI applications.		
7	Course Description	This course explores reinforcement learning, neural networks, deep learning, and large language models (LLMs). It covers AI architectures, optimization techniques, real-world applications, ethical concerns, and future AI trends.		
8	Outline syllabus			CO Mapping
	Unit 1	**Introduction to Reinforcement Learning**		
	A	Basics of reinforcement learning (RL) – Agents, actions, rewards, environments.		CO1

	B	Q-learning and policy-based RL methods – Concept, advantages, and applications.	CO2
	C	Implement Q-learning in a simple environment (e.g., GridWorld), and train an agent using Deep Q-Networks (DQN) in OpenAI Gym.	CO2
	Unit 2	**Neural Networks & Training**	
	A	Structure of neural networks – Neurons, layers, weights, and activation functions.	CO3
	B	Backpropagation and optimization techniques (Gradient Descent, Adam).	CO3
	C	Implement a simple feedforward neural network in PyTorch, experiment with activation functions, and train/test on small datasets.	CO3
	Unit 3	**Deep Learning Applications**	
	A	Introduction to deep learning architectures – CNNs, RNNs, LSTMs, and their key differences from traditional ML.	CO4
	B	Applications of deep learning in real-world problems like image recognition, speech processing, and healthcare.	CO4
	C	Implement CNNs for image classification (e.g., MNIST, CIFAR-10) and train RNNs/LSTMs for text generation tasks.	CO4
	Unit 4	**Feature Engineering & Model Evaluation**	
	A	Basics of Feature Engineering – Importance of feature selection, feature scaling, and feature transformation (PCA).	CO5
	B	Model Evaluation Techniques – Accuracy, Precision, Recall, F1-score, and ROC curves.	CO5
	C	Implement feature engineering techniques and compare model performance using different evaluation metrics on a real-world dataset	CO5
	Unit 5	**AI Ethics & Future Trends**	
	A	Challenges in AI ethics – Bias, fairness, and transparency in machine learning models.	CO5
	B	AI interpretability – SHAP, LIME, and explainability techniques.	CO5
	C	Explore model interpretability using SHAP/LIME and evaluate AI safety concerns in real-world applications.	CO6
	Mode of	Practical	

	examination				
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
AI3409.1	2	1	2	2	1	3	1	3	1	1	2			
AI3409.2	2	1	2	2	1	3	1	3	1	2	2			
AI3409.3	2	1	2	2	1	3	1	3	1	1	2			
AI3409.4	2	1	2	2	1	3	1	3	1	2	2			
AI3409.5	2	1	2	2	1	3	1	3	1	1	2			
AI3409.6	2	1	2	2	1	3	1	3	1	2	2			
Average	**2**	**1**	**2.0**	**2.0**	**1**	**3.0**	**1.0**	**3.0**	**1.0**	**1.5**	**2.0**			

School: SSES		**Batch: 2025-2029**	
Program: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**ARP306**	
2	Course Title	**Campus to Corporate**	
3	Credits	**2**	
4	Contact Hours (L-T-P)	**1-0-2**	
	Course Status	**AEC**	
5	Course Objective	To enhance holistic development of students and improve their employability skills. Provide a 360-degree exposure to learning elements of Business English readiness program, behavioural traits, achieve softer communication levels and a positive self-branding along with augmenting numerical and altitudinal abilities. To up skill and upgrade students across varied industry needs to enhance employability skills. By the end of this semester, a will have entered the threshold of his/her 4th phase of employability enhancement and skill building activity exercise.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Develop a creative resume, cover letters, interpret job descriptions and interpret KRA and KPI statements and art of conflict management. CO2: Build negotiation skills to get maximum benefits from deals in practical life scenarios. CO3: Develop skills of personal branding to create a brand image and self-branding CO4: Acquire higher level competency in use of logical and analytical reasoning such as direction sense, strong and weak arguments CO5: Develop higher level strategic thinking and diverse mathematical concepts through building analogies, odd one out CO6: Demonstrate higher level quantitative aptitude such as average, ratio & proportions, mixtures & allegation for making business decisions.	
7	Course Description	This penultimate stage introduces the student to the basics of Human Resources. Allows the student to understand and interpret KRA | KPI and understand Job descriptions. A student also understands how to manage conflicts, brand himself/herself, understand relations and empathise others with level-4 of quant, aptitude and logical reasoning	
8	Outline syllabus – ARP 306		
	Unit 1	**Ace the Interview**	**CO MAPPING**
	A	HR Sensitization (Role Clarity | KRA | KPI | Understanding JD) | Conflict Management	CO1
	B	Negotiation Skills | Personal Branding	CO3, CO4

	C	Uploading & Curating Resumes in Job Portals, getting Your Resumes Noticed | Writing Cover Letters | Relationship Management	CO1, CO3
	Unit 2	**Introduction to APTITUDE TRAINING- Reasoning- Logical/ Analytical**	
	A	Sitting Arrangement & Venn Diagrams | Puzzles | Distribution | Selection	CO4
	B	Direction Sense | Statement & Conclusion | Strong & Weak Arguments	CO4
	C	Analogies, Odd One out | Cause & Effect	CO5
	Unit 3	**Quantitative Aptitude**	
	A	Average , Ratio & Proportions, Mixtures & Allegation	CO6
	B	Geometry-Lines, Angles & Triangles	CO6
	C	Problem of Ages | Data Sufficiency - L2	CO6
	Unit 4	**Verbal Abilities-4**	
	A	Antonyms and Synonyms	CO1
	B	Idioms and Phrases	CO2
	Unit 5	**Problem Solving and Case Studies**	
	A	Real time Case Study Solving Exercises	CO4
	B	Intra student Mock Situation Handling Exercises	CO4
	Evaluation Weightage	(CA)Class Assignment/Free Speech Exercises / JAM – 30% | CE:30% (ESE) Group Presentations/Mock Interviews(MIP's)/GD/ Reasoning, Quant & Aptitude– 40%	
	Text book/s*	Wiley's Quantitative Aptitude-P Anand | **Quantum CAT – Arihant Publications | Quicker Maths- M. Tyra |** Power of Positive Action (English, Paperback, Napoleon Hill) | Streets of Attitude (English, Paperback, Cary Fagan, Elizabeth Wilson) The 6 Pillars of self-esteem and awareness – Nathaniel Brandon | Goal Setting (English, Paperback, Wilson Dobson	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
ARP306.1			2	2		3	1	3	1		2			
ARP306.2			3	2		3	1	3	1		2			
ARP306.3			2	2		3	1	3	1		2			
ARP306.4			2	2		3	1	3	1		2			
ARP306.5			2	2		3	1	3	1		2			
ARP306.6			2	2		3	1	3	1		2			
Average			**2.0**	**2.0**		**3.0**	**1.0**	**3.0**	**1.0**		**2.0**			

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**INC001**	
2	Course Title	**Industry Connect**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Project	
5	Course Objective	This course will expose students to applying theories learned in the classroom and provides current technological developments relevant to the subject area of training. Students will be able to identify their career preferences and professional goals.	
6	Course Outcomes	Students will be able to: CO1: Get familiar with industry principles and practices. CO2: Identify and analyze an appropriate problem. CO3: Develop teamwork and apply prior acquired knowledge in problem-solving. CO4: Demonstrate effective verbal and written communication skills. CO5: Practice scientists' responsibilities, self-understanding, self-discipline, and ethical standards. CO6: Identify the career preferences and professional goals.	
7	Course Description	The Internship aims to offer students the opportunity to apply their prior acquired knowledge in problem-solving. Students will acquire skills important for time management, discipline, self-learning, effective communication, and so on.	
8			
	Unit 1		
	A, B, C	Define objectives and conditions for the internship, ensuring students that it is related to the study path carried out at the University	CO1,CO6
	Unit 2		
	A, B, C	Problem Definition and identification, Team/Group formation, and Project Assignment. Finalizing the problem statement, and resource requirement, if any.	CO2,CO6,
	Unit 3		
	A, B, C	The internship work plan is drawn up by developing teamwork and applying prior acquired knowledge in problem-solving.	CO3,CO6,
	Unit 4		
	A, B, C	Demonstrate and execute Project with the team. Submission of the evaluation form and final report completed by the intern.	CO4,CO6
	Unit 5		
	A, B, C	Final evaluation form completed by the supervisor at the Host Organization and final presentation before the departmental committee.	CO5,CO6
	Mode of examination		
	Weightage Distribution	CA, CE:30%, ESE:40%	

	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
INC001.1		2	1	2	2	1	2	3	2	2	2	2	2	2
INC001.2		2	1	2	2	1	2	3	2	2	2	2	2	2
INC001.3		2	1	2	2	1	2	3	2	2	2	2	2	2
INC001.4		2	1	2	2	1	2	3	2	2	2	2	2	2
INC001.5		2	1	2	2	1	2	3	2	2	2	2	2	2
INC001.6		2	1	2	2	1	2	3	2	2	2	2	2	2
Average		**2.0**	**1.0**	**2.0**	**2.0**	**1.0**	**2.0**	**3.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**DAR3652**	
2	Course Title	**Research Based Learning-4**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Project (Audit-Qualifying)	
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 data science 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			
	Unit 1	**Introduction**	**CO1**
	Unit 2	**Case study**	**CO1,CO2**
	Unit 3	**Conceptual**	**CO3,CO4**
	Unit 4	**Development**	**CO4, CO5**
	Unit 5	**Finalisation**	**CO5, CO6**
	Mode of examination		
	Weightage Distribution	CA, CE:30%, ESE:40%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
DAR3652.1				2	3	3	3	3	3	3	3	3	1	1
DAR3652.2				2	3	3	3	3	3	3	3	3	1	1
DAR3652.3				2	3	3	3	3	3	3	3	3	1	1
DAR3652.4				2	3	3	3	3	3	3	3	3	1	1
DAR3652.5				2	3	3	3	3	3	3	3	3	1	1
DAR3652.6				2	3	3	3	3	3	3	3	3	1	1
Average				**2.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**1.0**	**1.0**

SEMESTER-VII

School: SSES	**Batch: 2025-29**	
Program: B.Sc(Hons. / Hons. With Research)	**Academic Year: 2028-29**	
Branch: Data Science & Analytics	**Semester: VII**	
Course Code	**MDA101**	
Course Title	**Foundations of Data Science**	
Credits	4	
Contact Hours (L-T-P)	4-0-0	
Course Status	Compulsory	
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.	
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 Python in a real-time environment. (K5, K6)	
Course Description	A PG-level course in the foundation of data science intended to verse students in the techniques necessary to understand and carry out methods in the foundation of data science.	
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 Data Science 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	**Basics of Python for Data Science**	
A	Introduction to Python: Installation, syntax, data structures	CO4

	(lists, tuples, dictionaries).			
B	Data manipulation using Pandas: Data Frames, handling missing values, basic operations.			CO4
C	Importing and working with data sources: CSV, Excel, Databases.			CO4, CO6
Unit 5	**Basic Data Mining**			
A	Data Mining Overview-Association Rule Mining.			CO5
B	Text Mining-Supervised and Unsupervised Learning.			CO5
C	Supervised Learning via Support Vector Machines- Support			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**	**2**	**3**	**3**	**0**	**3**	**3**	**2**	**1**
MDA101.2	**3**	**1**	**3**	**3**	**0**	**3**	**2**	**1**	**1**
MDA101.3	**2**	**2**	**2**	**3**	**0**	**2**	**2**	**1**	**1**
MDA101.4	**2**	**2**	**3**	**3**	**0**	**2**	**3**	**1**	**1**
MDA101.5	**3**	**3**	**3**	**3**	**0**	**3**	**2**	**2**	**2**
MDA101.6	**3**	**3**	**3**	**3**	**0**	**2**	**2**	**1**	**2**

School: SSES	**Batch: 2025-29**	
Program: B.Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**	
Branch: Data Science & Analytics	**Semester: VII**	
Course Code	MDA102	
Course Title	Mathematics for Machine Learning	
Credits	4	
Contact Hours(L-T-P)	4-0-0	
Course Status	Compulsory	
Course Objective	To enable the students to understand the concept of mathematics in machine learning.	
Course Outcomes	CO1: Solve a system of Linear equations by applying the Gauss Eliminationmethod. (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 a Matrix. (K1, K2, K3) CO4: Evaluate Eigen values and Eigen vectors using Lineartransformation and power methods. (K3, K4) CO5: Evaluate Derivatives and Partial Derivatives using rules of differentiation. (K4, K5) CO6: Apply optimization using gradient function. (K5, K6)	
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.	
Outline syllabus		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, Solving System of Linear equations.	CO2
B	Linear Independence, Vectors, Scalars, Addition, Scalarmultiplication.	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 EngineeringMathematics, 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**	**0**	**2**	**3**	**0**	**3**	**3**	**2**	**1**
MDA102.2	**3**	**0**	**2**	**3**	**0**	**3**	**2**	**1**	**1**
MDA102.3	**3**	**0**	**2**	**3**	**0**	**2**	**2**	**1**	**1**
MDA102.4	**3**	**0**	**2**	**3**	**0**	**2**	**3**	**1**	**1**
MDA102.5	**3**	**0**	**2**	**3**	**0**	**3**	**2**	**2**	**2**
MDA102.6	**3**	**0**	**2**	**3**	**0**	**2**	**2**	**1**	**2**

School: SSES	**Batch: 2025-29**	
Program: B.Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**	
Branch: Data Science & Analytics	**Semester: VII**	
Course Code	**STT4701**	
Course Title	**Distribution Theory**	
Credits	4	
Contact Hours (L-T-P)	4-0-0	
Course Status	Compulsory	
Course Objective	This course explores probability distributions, their properties, and applications in statistical modeling. It covers univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, equipping students with essential skills for statistical inference and data analysis.	
Course Outcomes	After completion of this course, students will be able to CO1: Understand and analyze various univariate discrete probability distributions, derive their properties, and apply them to real-world problems. (K2, K3, K4) CO2: Explore univariate continuous probability distributions, derive their properties, and utilize them in practical applications. (K4, K5) CO3: Examine bivariate distributions and key sampling distributions (Chi-square, t, F), their interrelationships, and their role in statistical inference. (K4, K5) CO4: Investigate non-central and compound probability distributions, along with truncation techniques, and assess their applications in statistical modeling. (K3, K4) CO5: Analyze order statistics, their distributions, recurrence relations, and related systematic statistics for deriving statistical properties. (K4, K5) CO6: Understand and apply concepts related to interrelationships in sampling distributions, truncation effects, and mixture distributions, including finite mixtures and zero-modified distributions. (K5,K6)	
Course Description	This course covers probability distributions, their properties, and applications in statistical modeling. Topics include univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, preparing students for statistical inference and data analysis.	
		CO Mapping
Unit 1	**Univariate Discrete Distributions (Derivation, properties and applications)**	
A	Discrete Uniform distribution, Binomial, Multinomial, Poisson distribution	CO1
B	Negative binomial, geometric distribution	CO1
C	Hyper geometric distribution, power series Distribution	CO1
Unit 2	**Univariate Continuous Distributions (Derivation, properties and applications)**	
A	Exponential, Gamma distribution and Lindley distribution	CO2
B	Beta (1st kind and 2nd kind), Weibull, Cauchy distribution	CO2
C	Normal and Log-normal distribution, Pareto and Rayleigh distribution	CO2

Unit 3	**Bivariate Distributions and Sampling Distributions**	
A	Derivation, properties and applications of bivariate normal distribution	CO3
B	Derivation, properties and applications of Chi-square, t and F-distributions and	CO3
C	Interrelationship between sampling distribution.	CO3, CO6
Unit 4	**Non-central Distributions, Compound Distributions and Truncation**	
A	Non-central chi-square, t and F distributions	CO4
B	Compound distribution- Neyman's Type A distribution, Polya-Eggenberger distribution, Inverse Polya-Eggenberger distribution	CO4
C	Truncation of basic discrete and continuous distributions with their properties.	CO4, CO6
Unit 5	**Order Statistics and Mixture Distribution**	
A	Distributions of r-th order statistics, joint density of two order statistics, some special joint distributions resulting from order statistics	CO5
B	Distribution of range and other systematic statistics, moments of order statistics, recurrence relations and identities for moments of order statistics from an arbitrary distribution	CO5
C	Mixture distribution- finite mixture, zero-modified distributions, mixture of binomial distribution.	CO5, CO6
Mode of examination	**Theory**	
Weightage Distribution	CA: 25 % / MTE: 25 % / ETE: 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
STT4701.1	**3**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**1**
STT4701.2	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**1**	**1**
STT4701.3	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**
STT4701.4	**3**	**2**	**2**	**3**	**-**	**2**	**3**	**1**	**1**
STT4701.5	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**2**	**1**
STT4701.6	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**

School: SSES	**Batch: 2025-29**
Programme: B. Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**
Branch: Data Science & Analytics	**Semester: VII**
Course Code.	STT4704
Course Title	Statistical Methods
Credits	4
Contact Hours (L-T-P)	4-0-0
Course status	Compulsory
Course Objectives	This course aims to develop a strong foundation in descriptive statistics, probability theory, and statistical inference. Students will learn key concepts such as probability spaces, random variables, probability functions, generating functions, and hypothesis testing. The course also covers laws of large numbers, probability inequalities, and central limit theorems, equipping students with essential tools for data analysis and statistical modeling.
Course Outcomes	CO1: Understand and analyze descriptive statistics, measures of central tendency, dispersion, and fundamental set theory concepts. (K1, K2, K6) CO2: Grasp fundamental probability concepts, including probability spaces, independence, conditional probability, and Bayes' theorem. (K1,K2,K4) CO3:Explore random variables, probability functions, mathematical expectations, and probability inequalities. (K2,K3,K4) CO4: Analyze bivariate distributions, marginal and conditional distributions, and their statistical implications. (K2,K4) CO5: Understand generating functions, hypothesis testing, and statistical inference concepts, including Type I & II errors. (K1,K2, K5) CO6: Apply laws of large numbers, central limit theorems, and statistical inequalities in probability and inference.. (K2,K3,K4)
Course Description	This course covers descriptive statistics, probability theory, random variables, probability distributions, generating functions, and hypothesis testing. It also explores laws of large numbers, probability inequalities, and central limit theorems for statistical analysis and decision-making.

Outline syllabus:

UNIT1	**Descriptive Statistics and Probability**	CO Mapping
A	Representation of data (measures of central tendency).	CO1
B	Dispersion & other characteristics of data (mean deviation, variance, quartiles, Skewness and Kurtosis, Moments).	CO1
C	Classes of Sets, Fields, sigma-fields, minimal sigma-field, Borel field	CO1
UNIT 2	**Probability: Basic Concepts and Conditional Probability**	
A	Probability space, Basic terminologies and theorems on probability, theorem of total probability, theorems on compound probability	CO2
B	Independence of events, conditional probability	CO2

C	Bayes' Theorem and its applications			CO2
UNIT 3	**Random Variables and Probability Functions**			
A	Random Variable and its properties, mathematical expectation and inequalities involving random variables viz. Markov's, Holder's, Minkowski's and Jenson's Inequalities			CO3
B	PDF, PMF, Distribution function			CO3
C	Bivariate random variables, Marginal and conditional distributions			CO3, CO4
UNIT 4	**Generating Functions and Hypothesis**			
A	Generating functions, probability generating function, moment generating function characteristic functions,			CO3, CO5
B	factorial moment generating functions, Uniqueness theorem.			CO5,CO6
C	Hypothesis testing, Type I and II error, Level of Significance, power of test, Large and small sample test.			CO5,CO6
UNIT 5	**The Laws of Large Numbers, Inequalities and Central limit Theorem**			
A	Law of large numbers, Chebychev's and Khinchin's weak law of large numbers, Kolmogorov's theorem, Strong law of large numbers.			CO5,CO6
B	Central limit theorem, De-Moivre's Laplace central limit theorem.			CO5,CO6
C	Statement of Lindeberg- Feller's central limit theorem.			CO5,CO6
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		25%	25%	50%
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics". Sultan Chand & sons.		
	Other references	1.Ash, Robert B. (2000). Probability and Measure Theory, Second Edition, Academic Press, New York. 2. Feller, W. (1985). Introduction to Probability Theory and its Applications, Wiley Eastern, New Delhi 3. Bhatt, B.R. (1999). Modern Probability Theory, 3rd Edition, New Age International Publishers. 4. A. K. Md. Ehsanes Saleh and Vijay K. Rohatgi (2010) An Introduction to Probability and STATistics, Wiley India Pvt. Ltd.		

COURSE OUTCOMES – PROGRAMMEME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4704.1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**
STT4704.2	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**2**
STT4704.3	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
STT4704.4	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**
STT4704.5	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**
STT4704.6	**3**	**2**	**1**	**3**	**2**	**2**	**2**	**1**	**2**

School: SSES		**Batch: 2025-29**	
Program: B.Sc. (Hons. /Hons. With research)		**Academic Year: 2028**	
Branch: Data Science & Analytics		**Semester: VII**	
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	CO3

		constraints, associative memory, and characteristics, limitations, and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation, and training. Associative Memory.			
	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: SSES		**Batch: 2025-29**			
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**			
Branch: Data Science & Analytics		**Semester: VII**			
1	Course Code	**DAP4754**			
2	Course Title	Data Science Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in data science using Python, covering data handling, exploratory data analysis (EDA), preprocessing, and basic machine learning techniques.			
6	Course Outcomes	CO1: Understand basic Python concepts for data science.(K1, K2) CO2: Perform data visualization and EDA. (K2, K3) CO3: Apply data preprocessing techniques like cleaning and transformation. (K3, K4) CO4: Work with different data sources and manage datasets.(K4, K5) CO5: Implement basic machine learning algorithms.(K5, K6) CO6: Build simple web applications using Python.(K4, K6)			
7	Course Description	This practical course focuses on implementing foundational data science techniques using Python. Students will work with real-world datasets to perform exploratory analysis, data preprocessing, statistical modeling, and machine learning.			
8	Outline syllabus				CO Mapping
	Unit 1	**Introduction to Python and Data Science**			
		Python basics, installation, and libraries (NumPy, Pandas). Handling datasets and understanding the data science workflow.			CO1
	Unit 2	**Exploratory Data Analysis (EDA) in Python**			
		Summary statistics, histograms, boxplots, scatter plots. Understanding data patterns and relationships.			CO2
	Unit 3	**Data Preprocessing and Feature Selection in Python**			
		Handling missing values and outliers. Feature selection techniques (Decision Trees, Wrappers, Filters).			CO3
	Unit 4	**Working with Data Sources**			
		Importing and manipulating data from CSV, Excel, and databases. Using Python for data retrieval.			CO4
	Unit 5	**Data Mining and Machine Learning**			
		Basic supervised and unsupervised learning (Association, Regression, Clustering).			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		30 %	30 %	40 %	
	Text book				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAP4754.1	1	3	1	1	1	3	3	2	2
DAP4754.2	1	3	1	1	1	3	2	1	2
DAP4754.3	1	3	1	1	1	2	2	1	2
DAP4754.4	1	3	1	1	1	2	3	1	2
DAP4754.5	1	3	1	1	1	3	2	2	2
DAP4754.6	1	3	1	1	1	2	2	1	2

School: SSES		**Batch: 2025-29**			
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**			
Branch: Data Science & Analytics		**Semester: VII**			
1	Course Code	**DAP4755**			
2	Course Title	Mathematics for Machine Learning Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in mathematics functions using Python			
6	Course Outcomes	CO1: Implement matrix operations, determinants, and eigenvalues using Python (K1,K2) CO2: Apply vector operations and solve systems of linear equations. (K2,K3) CO3: Understand vector spaces and perform vector transformations. (K2,K3,K4) CO4: Compute derivatives, gradients, and implement PCA. (K3,K4) CO5: Apply differentiation techniques and compute function derivatives. (K4,K5) CO6: Implement optimization techniques using gradient functions. (K4,K5)			
7	Course Description	Introduce basic concepts of Python environment and provide students with a general understanding of R/ Python for solving the data analytics based problem. Equip students With the skills to apply Python concepts and analytical tools to analyze data analytics problem and handle real-world issues.			
8	Outline syllabus				CO Mapping
	Unit 1	**Matrices and Determinants**			
		Implementing matrix operations: Addition, multiplication, inverse, and rank. Computing determinants, eigenvalues, and eigenvectors using NumPy.			CO1
	Unit 2	**Linear Algebra Concepts**			
		Solving systems of linear equations using Gaussian elimination and NumPy functions. Implementing vector operations: Dot product, scalar multiplication, and cosine similarity.			CO2
	Unit 3	**Vector Operations and Spaces**			
		Working with orthogonal, normal, and orthonormal vectors. Computing vector norms, basis vectors, and affine spaces.			CO3, CO6
	Unit 4	**Differentiation and PCA**			
		Implementing differentiation and partial derivatives using SymPy. Performing Principal Component Analysis (PCA) for dimensionality reduction			CO4, CO6
	Unit 5	**Optimization and Gradient Functions**			
		Computing gradients of scalar and vector functions using Autograd. Implementing constrained optimization using Lagrange multipliers. Applying convex optimization techniques in machine learning problems.			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book				

	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAP4755.1	1	3	1	1	1	3	3	1	2
DAP4755.2	1	3	1	1	1	3	2	1	2
DAP4755.3	1	3	1	1	1	2	2	1	2
DAP4755.4	1	3	1	1	1	2	3	1	2
DAP4755.5	1	3	1	1	1	3	2	1	2
DAP4755.6	1	3	1	1	1	2	2	1	2

School: SSES		**Batch: 2025-29**	
Program: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VII**	
1	Course Code	**STP4753**	
2	Course Title	**Distributions Theory Lab**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Compulsory	
5	Course Objective	To provide hands-on experience in solving probability-related problems and statistical distributions using computational tools and real-life data applications.	
6	Course Outcomes	CO1: Demonstrate probability concepts using computational tools. (K2, K3, K4) CO2: Analyze and visualize probability distributions and density functions. (K4, K5) CO3: Compute and interpret expectations and moment-generating functions. (K4, K5) CO4: Implement various types of generating functions in statistical analysis. (K3, K4) CO5: Apply sampling distributions for hypothesis testing. (K4, K5) CO6: Utilize statistical methods to solve real-world problems. (K5, K6)	
7	Course Description	This practical course reinforces the theoretical foundations of probability theory and distributions through computational simulations and data analysis. Students will use programming tools such as R or Python to implement probability models, derive distributions, and perform hypothesis testing.	
8	Outline syllabus		CO Mapping
	Unit 1	**Basic Probability Concepts and Random Variables**	
		Problem based on conditional probability and Bayes' theorem using real-world data. Also Visualization of probability distributions (discrete and continuous)	CO1 CO2
	Unit 2	**Expectations and Inequalities**	
		Problem based on expectation, variance, and covariance of random variables, Conditional expectation and variance calculations. Verification of probability inequalities (Markov, Chebyshev, etc.) using data	CO2, CO3
	Unit 3	**Generating Functions and Discrete Distributions**	
		Problem based on moment generating functions and probability generating functions. Simulating and analyzing discrete distributions (Bernoulli, Binomial, Poisson, etc.)	CO3, CO4
	Unit 4	**Continuous Distributions**	
		Problem based on Simulation and visualization of continuous distributions (Normal, Exponential, Gamma, Beta, etc.)	CO4,CO5
	Unit 5	**Sampling Distributions and Hypothesis Testing**	

		Problem based on Sampling distribution of sample mean and proportion Performing hypothesis tests using t, F, and chi-square distributions. Real-life case studies involving hypothesis testing			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STP4753.1	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**
STP4753.2	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**
STP4753.3	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**
STP4753.4	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**
STP4753.5	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**
STP4753.6	**1**	**1**	**3**	**3**		**1**	**2**	**1**	**2**

School: SSES		**Batch: 2025-29**			
Program: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**			
Branch: Data Science & Analytics		**Semester: VII**			
1	Course Code	**STP4752**			
2	Course Title	**Statistical Method Lab**			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in solving statistical and probability-related problems using computational tools and real-life data applications.			
6	Course Outcomes	After the completion of this course, students will be able to: CO1: Demonstrate descriptive statistical measures and probability concepts using computational tools. (K2, K3, K4) CO2: Analyze correlation, regression, and curve fitting techniques. (K4, K5) CO3: Implement regression models and evaluate their effectiveness. (K4, K5) CO4: Perform hypothesis testing using various parametric and non-parametric tests. (K3, K4) CO5: Apply design of experiments in statistical data analysis. (K4, K5) CO6: Utilize measure theory concepts in probability and statistical applications. (K5, K6)			
7	Course Description	This practical course reinforces the theoretical foundations of descriptive statistics, probability, correlation, regression, hypothesis testing, design of experiments, and measure theory through computational simulations and data analysis. Students will use programming tools such as R or Python to implement statistical models and conduct real-world data-driven analysis.			
8	Outline syllabus				CO Mapping
	Unit 1	**Descriptive Statistics**			CO1
		Problem Based on Descriptive Statistics using R or Python			
	Unit 2	**Probability**			CO2, CO3
		Problem Based on probability using R or Python			
	Unit 3	**Random Variable and Distribution Function**			CO4
		Problem based on random variable and distribution functions using R or Python			
	Unit 4	**Testing of Hypothesis**			CO5
		Problem based on testing of Hypothesis using R or Python			
	Unit 5	**Inequalities and Central limit Theorem**			CO6
		Problem based on inequalities and central limit theorem using R or Python			
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ETE	
		30%	30%	40%	
	Text book/s*	• Introduction to Probability and Statistics by S.C. Gupta & V.K. Kapoor			

		• Probability and Statistical Inference by Robert V. Hogg & Elliot A. Tanis	
	Other References	• Introduction to Probability Models by Sheldon M. Ross • Computational Probability and Statistics using R/Python (Online Resources)	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STP4752.1	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
STP4752.2	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
STP4752.3	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
STP4752.4	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
STP4752.5	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**
STP4752.6	**1**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**2**

SEMESTER – VIII

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	**MDA117**	
2	Course Title	**Computational Intelligence**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	To provide a strong foundation on fundamental concepts in Computational Intelligence. To enable Problem-solving through various searching techniques.	
6	Course Outcomes	CO1: Provide a basic exposition to the goals and methods of Computational Intelligence. CO2: Study of the design of intelligent computational techniques. CO3: Apply the Intelligent techniques for problem solving CO4: Improve problem solving skills using the acquired knowledge in the areas of reasoning, natural language understanding, computer vision, automatic programming and machine learning. CO5: Learn about the advance concept of AI CO6: Explain computable functions, predicates, forward and backward reasoning	
7	Course Description	To apply these techniques in applications which involve perception, reasoning and learning. To apply Computational Intelligence techniques for information retrieval. To apply Computational Intelligence techniques primarily for machine learning.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Introduction to Artificial Intelligence-Search-Heuristic	CO1,
	B	Search A* algorithm Game Playing Alpha Beta Pruning Expert systems	CO1,
	C	Inference Rules Forward Chaining and Backward Chaining Genetic Algorithms	CO1,
	Unit 2		

	A	Proposition Logic First Order Predicate Logic Unification Forward Chaining	CO2
	B	Backward Chaining Resolution Knowledge Representation Ontological Engineering Categories and Objects	CO2
	C	Event Mental Events and Mental Objects Reasoning Systems for Categories Reasoning with Default Information Prolog Programming.	CO3
	Unit 3		
	A	Non-monotonic reasoning-Fuzzy	CO4
	B	Logic Fuzzy rules fuzzy inference Temporal Logic	CO4
	C	Temporal Reasoning Neural Networks Neuro Fuzzy Inference.	CO4
	Unit 4		
	A	Probability basics - Bayes Rule and its Applications Bayesian Networks Exact and Approximate Inference in Bayesian Networks Hidden Markov Models Forms of Learning	CO5
	B	Supervised Learning - Learning Decision Trees – Regression and Classification with Linear Models - Artificial Neural Networks –	CO5
	C	Nonparametric Models Support Vector Machines Statistical Learning, Learning with Complete Data Learning with Hidden Variables- The EM Algorithm Reinforcement Learning.	CO5
	Unit 5		
	A	Natural language processing-Morphological Analysis Syntax analysis	CO6
	B	Semantic Analysis All applications Language Models Information Retrieval Information	CO6
	C	Extraction Machine Translation Machine Learning Symbol Based Machine Learning: Connectionist Machine Learning.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ESE:75%	
	Text book/s*	1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach‖, Third Edition, Pearson Education / Prentice Hall of India. 2. Elaine Rich and Kevin Knight, Artificial Intelligence‖, Third Edition, Tata McGraw- Hill.	
	Other References	1. Patrick H. Winston. "Artificial Intelligence", Third edition, Pearson Edition. 2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems‖, PHI.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MDA117.1		2	1	2		1		3			3		1	1
MDA117.2		2	1	2		1		3			3		1	1
MDA117.3		2	1	2		1		3			3		1	1
MDA117.4		2	1	2		1		3			3		1	1
MDA117.5		2	1	2		1		3			3		1	1
MDA117.6		2	1	2		1		3			3		1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**3.0**		**1.0**	**1.0**

School: SSES		**Batch: 2025-29**
Program: B.Sc.(Hons. / Hons. With Research)		**Academic Year: 2028-29**
Branch: Data Science & Analytics		**Semester: VIII**
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 variousdata 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: SSES	**Batch: 2025-27**	
Program: B.Sc. (Hons. /Hons. With Research)	**Academic Year: 2025-26**	
Branch: Data Science & Analytics	**Semester: VIII**	
Course Code	**MDA107**	
Course Title	**Advanced Big Data and Text Analytics**	
Credits	4	
Contact Hours (L-T-P)	4-0-0	
Course Status	DSE	
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.	
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.	
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.	
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, Issues in Stream Processing.	CO2
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: SSES	**Batch: 2025-27**	
Program: B.Sc. (Hons./Hons. With Research)	**Academic Year: 2025-26**	
Branch: Data Science & Analytics	**Semester: VIII**	
Course Code	**MDA105**	
Course Title	**Regression Analytics and Predictive Models**	
Credits	4	
Contact Hours(L-T-P)	4-0-0	
Course Status	Compulsory	
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.	
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 multi collinearity.** **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.**	
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.	
Outline syllabus		CO Mapping
Unit 1	**Correlation and Simple linear regression**	
A	Correlation, Types of Correlation, Rank Correlation, Simple linear regression model. Least- squares estimation of parameters. Hypothesis testing on the slope and intercept.	CO1
B	Interval estimation in simple linear regression. Coefficient of determination. Estimation by maximum likelihood.	CO1
C	Properties of BLUEs and the residual sum of squares under normality, Gauss-Markov Model.	CO1
Unit 2	**Multiple linear regression**	
A	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.	CO2

B	Properties of least square estimator, confidence intervals for mean, regression coefficients and prediction in multiple regression, collinearity			CO2
C	Inverse regression, two-phase linear regression, inclusion of qualitative variable as regressors, multiple and partial correlations.			CO2
Unit 3	**Logistic regression and Model Adequacy**			
A	Logistic Regression: Introduction, Linear predictor and link functions, logit, probit, odds ratio, the test of hypothesis. Discriminant Analysis.			CO3
B	Model Adequacy: Checking of linearity between study and explanatory variable, Residual Analysis, Detection and treatment of outliers, Residual plots.			CO3
C	The PRESS statistic. Outlier test based on Studentized Residual (R-student). Test for lack of fit of the regression model.			CO3
Unit 4	**Generalized Linear models and Logistic Regression**			
A	Basic concept of generalized linear models.			CO4
B	Logit transformation, maximum likelihood estimation			CO4
C	Tests of hypothesis: Wald test, likelihood ratio (LR) test, score test, test for overall regression			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: SSES	**Batch: 2025-27**
Program: B.Sc. (Hons. With Research)	**Academic Year: 2025-26**
Branch: Data Science & Analytics	**Semester: VIII**
Course Code	**DAR4856**
Course Title	**Project**
Credits	4
Contact Hours (L-T-P)	0-0-8
Course Status	Compulsory
Course Objective	This course introduces students to problem identification, literature review, and data collection for a Data Science project.
Course Outcomes	CO1: Identify a research problem and define objectives. (K2, K3) CO2: Conduct literature review and feasibility study. (K3) CO3: Collect, organize, and preprocess relevant data. (K3, K4) CO4: Analyze data to explore patterns and relationships. (K4) CO5: Develop a structured project proposal. (K5) CO6: Present initial findings in a report and presentation. (K5, K6)
Course Description	This course introduces students to problem identification, literature review, and data collection for a Data Science project. It helps students develop a structured approach to research, establish objectives, and prepare a comprehensive project proposal.

Outline syllabus		CO Mapping
Unit 1	**Project Planning and Problem Identification**	
A	Selection of a topic and defining project scope	CO1
B	Literature review and feasibility analysis	CO1
C	Setting research objectives and expected outcomes	CO1
Unit 2	**Data Collection and Organization**	
A	Identifying sources of data	CO2
B	Collection, structuring, and documentation of data	CO2
C	Handling and managing missing or inconsistent data	CO2
Unit 3	**Initial Data Analysis**	
A	Exploring data characteristics	CO3
B	Identifying trends, patterns, and correlations	CO3
C	Generating preliminary insights	CO3
Unit 4	**Project Proposal Development**	
A	Outlining project methodology and approach	CO4
B	Identifying evaluation criteria	CO4
C	Addressing potential challenges and limitations	CO4
Unit 5	**Presentation and Review**	
A	Structuring and formatting the proposal	CO5
B	Preparing visual and written reports	CO6
C	Presenting and refining based on feedback	CO6

Mode of examination				
Weightage Distribution	CA	CE	ETE	
	30%	30%	40%	
Text book/s*	• The Data Science Handbook – Carl Shan, Henry Wang, William Chen, and Max Song • Practical Research: Planning and Design – Paul D. Leedy and Jeanne Ellis Ormrod			
Other References	• Exploratory Data Analysis with Python – John W. Tukey • The Craft of Research – Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams			

COURSE OUTCOMES– PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAR4856.1	3	2	3	3	2	3	2	3	3
DAR4856.2	3	2	3	3	2	3	2	3	3
DAR4856.3	3	3	3	3	3	3	2	3	3
DAR4856.4	3	3	3	3	3	3	3	3	3
DAR4856.5	3	3	3	3	3	3	3	3	3
DAR4856.6	3	3	3	3	3	3	3	3	3

(OR)

SEMESTER-VII

School: SSES	**Batch: 2025-29**
Program: B.Sc(Hons. / Hons. With Research)	**Academic Year: 2028-29**
Branch: Data Science & Analytics	**Semester: VII**
Course Code	**MDA101**
Course Title	**Foundations of Data Science**
Credits	4
Contact Hours (L-T-P)	4-0-0
Course Status	Compulsory
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.
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 Python in a real-time environment. (K5, K6)
Course Description	A PG-level course in the foundation of data science intended to verse students in the techniques necessary to understand and carry out methods in the foundation of data science.
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 Data Science 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	**Basics of Python for Data Science**	
A	Introduction to Python: Installation, syntax, data structures (lists, tuples, dictionaries).	CO4
B	Data manipulation using Pandas: Data Frames, handling missing values, basic operations.	CO4
C	Importing and working with data sources: CSV, Excel, Databases.	CO4, CO6
Unit 5	**Basic Data Mining**	
A	Data Mining Overview-Association Rule Mining.	CO5
B	Text Mining-Supervised and Unsupervised Learning.	CO5
C	Supervised Learning via Support Vector Machines- Support	CO5, CO6
Mode of examination	**Theory**	
Weightage Distribution	CA: 25% / MTE: 25% / ETE: 50%	
Text book/s*	1. Jeffrey S. Saltz, Jeffre M. Stanton, "AnIntroduction to Data Science", Sage Publications.	
Other References	5. Nina Zumal, John Mount (2014). Practical Data science in R, Managing Publication Company 6. Bernard Kolman, Robert C. Busby and Sharon Ross (2004). Discrete Mathematical Structures, New Delhi: Prentice Hall 7. V. Bhuvaneswari, T. Devi, (2016). Big Data Analytics: A Practitioner's Approach, Bharathiar University 8. 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**	**2**	**3**	**3**	**0**	**3**	**3**	**2**	**1**
MDA101.2	**3**	**1**	**3**	**3**	**0**	**3**	**2**	**1**	**1**

MDA101.3	**2**	**2**	**2**	**3**	**0**	**2**	**2**	**1**	**1**
MDA101.4	**2**	**2**	**3**	**3**	**0**	**2**	**3**	**1**	**1**
MDA101.5	**3**	**3**	**3**	**3**	**0**	**3**	**2**	**2**	**2**
MDA101.6	**3**	**3**	**3**	**3**	**0**	**2**	**2**	**1**	**2**

School: SSES	**Batch: 2025-29**	
Program: B.Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**	
Branch: Data Science & Analytics	**Semester: VII**	
Course Code	MDA102	
Course Title	Mathematics for Machine Learning	
Credits	4	
Contact Hours(L-T-P)	4-0-0	
Course Status	Compulsory	
Course Objective	To enable the students to understand the concept of mathematics in machine learning.	
Course Outcomes	CO1: Solve a system of Linear equations by applying the Gauss Eliminationmethod. (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 a Matrix. (K1, K2, K3) CO4: Evaluate Eigen values and Eigen vectors using Lineartransformation and power methods. (K3, K4) CO5: Evaluate Derivatives and Partial Derivatives using rules of differentiation. (K4, K5) CO6: Apply optimization using gradient function. (K5, K6)	
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.	
Outline syllabus		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	CO4

	properties.			
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 EngineeringMathematics, 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**	**0**	**2**	**3**	**0**	**3**	**3**	**2**	**1**
MDA102.2	**3**	**0**	**2**	**3**	**0**	**3**	**2**	**1**	**1**
MDA102.3	**3**	**0**	**2**	**3**	**0**	**2**	**2**	**1**	**1**
MDA102.4	**3**	**0**	**2**	**3**	**0**	**2**	**3**	**1**	**1**
MDA102.5	**3**	**0**	**2**	**3**	**0**	**3**	**2**	**2**	**2**
MDA102.6	**3**	**0**	**2**	**3**	**0**	**2**	**2**	**1**	**2**

School: SSES	**Batch: 2025-29**
Program: B.Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**
Branch: Data Science & Analytics	**Semester: VII**
Course Code	**STT4701**
Course Title	**Distribution Theory**
Credits	4
Contact Hours (L-T-P)	4-0-0
Course Status	Compulsory
Course Objective	This course explores probability distributions, their properties, and applications in statistical modeling. It covers univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, equipping students with essential skills for statistical inference and data analysis.
Course Outcomes	After completion of this course, students will be able to CO1: Understand and analyze various univariate discrete probability distributions, derive their properties, and apply them to real-world problems. (K2, K3, K4) CO2: Explore univariate continuous probability distributions, derive their properties, and utilize them in practical applications. (K4, K5) CO3: Examine bivariate distributions and key sampling distributions (Chi-square, t, F), their interrelationships, and their role in statistical inference. (K4, K5) CO4: Investigate non-central and compound probability distributions, along with truncation techniques, and assess their applications in statistical modeling. (K3, K4) CO5: Analyze order statistics, their distributions, recurrence relations, and related systematic statistics for deriving statistical properties. (K4, K5) CO6: Understand and apply concepts related to interrelationships in sampling distributions, truncation effects, and mixture distributions, including finite mixtures and zero-modified distributions. (K5,K6)

Course Description	This course covers probability distributions, their properties, and applications in statistical modeling. Topics include univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, preparing students for statistical inference and data analysis.			
				CO Mapping
Unit 1	**Univariate Discrete Distributions (Derivation, properties and applications)**			
A	Discrete Uniform distribution, Binomial, Multinomial, Poisson distribution			CO1
B	Negative binomial, geometric distribution			CO1
C	Hyper geometric distribution, power series Distribution			CO1
Unit 2	**Univariate Continuous Distributions (Derivation, properties and applications)**			
A	Exponential, Gamma distribution and Lindley distribution			CO2
B	Beta (1st kind and 2nd kind), Weibull, Cauchy distribution			CO2
C	Normal and Log-normal distribution, Pareto and Rayleigh distribution			CO2
Unit 3	**Bivariate Distributions and Sampling Distributions**			
A	Derivation, properties and applications of bivariate normal distribution			CO3
B	Derivation, properties and applications of Chi-square, t and F-distributions and			CO3
C	Interrelationship between sampling distribution.			CO3, CO6
Unit 4	**Non-central Distributions, Compound Distributions and Truncation**			
A	Non-central chi-square, t and F distributions			CO4
B	Compound distribution- Neyman's Type A distribution, Polya-Eggenberger distribution, Inverse Polya-Eggenberger distribution			CO4
C	Truncation of basic discrete and continuous distributions with their properties.			CO4, CO6
Unit 5	**Order Statistics and Mixture Distribution**			
A	Distributions of r-th order statistics, joint density of two order statistics, some special joint distributions resulting from order statistics			CO5
B	Distribution of range and other systematic statistics, moments of order statistics, recurrence relations and identities for moments of order statistics from an arbitrary distribution			CO5
C	Mixture distribution- finite mixture, zero-modified distributions, mixture of binomial distribution.			CO5, CO6
Mode of examination	**Theory**			
Weightage Distribution	CA	MTE	ETE	
	25 %	25 %	50 %	

Text book/s*	4. Sheldon Ross; A First Course in Probability,Pearson, 2014. 5. Parimal Mukhopadhyay; An Introduction to theTheory of Probability, World scientific, 2012. 6. Irwin Miller, Marylee's Miller, John E. Freund's;Mathematical Statistics, Pearson, 2017	
Other References	5. FetsjeBijma, Marianne Jonker and Aad van der Vaart; Introduction to Mathematical Statistics, Amsterdam University Press, 2018. 6. Krishnamoorthy, K., Handbook of Statistical Distributions with Applications, Chapman & Hall/CRC, 2006. 7. Rohatgi, V.K. and Ebsanes Saleh, A.K. Md., An introduction to Probability and Statistics, 2nd Ed.,John Wiley & Sons, 2002. 8. 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
STT4701.1	**3**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**1**
STT4701.2	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**1**	**1**
STT4701.3	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**
STT4701.4	**3**	**2**	**2**	**3**	**-**	**2**	**3**	**1**	**1**
STT4701.5	**3**	**2**	**2**	**3**	**-**	**3**	**2**	**2**	**1**
STT4701.6	**3**	**2**	**2**	**3**	**-**	**2**	**2**	**1**	**1**

School: SSES	**Batch: 2025-29**
Programme: B. Sc. (Hons. / Hons. With Research)	**Academic Year: 2028-29**
Branch: Data Science & Analytics	**Semester: VII**
Course Code.	STT4704
Course Title	Statistical Methods
Credits	4
Contact Hours (L-T-P)	4-0-0
Course status	Compulsory

Course Objectives	This course aims to develop a strong foundation in descriptive statistics, probability theory, and statistical inference. Students will learn key concepts such as probability spaces, random variables, probability functions, generating functions, and hypothesis testing. The course also covers laws of large numbers, probability inequalities, and central limit theorems, equipping students with essential tools for data analysis and statistical modeling.
Course Outcomes	CO1: Understand and analyze descriptive statistics, measures of central tendency, dispersion, and fundamental set theory concepts. (K1, K2, K6) CO2: Grasp fundamental probability concepts, including probability spaces, independence, conditional probability, and Bayes' theorem. (K1,K2,K4) CO3:Explore random variables, probability functions, mathematical expectations, and probability inequalities. (K2,K3,K4) CO4: Analyze bivariate distributions, marginal and conditional distributions, and their statistical implications. (K2,K4) CO5: Understand generating functions, hypothesis testing, and statistical inference concepts, including Type I & II errors. (K1,K2, K5) CO6: Apply laws of large numbers, central limit theorems, and statistical inequalities in probability and inference.. (K2,K3,K4)
Course Description	This course covers descriptive statistics, probability theory, random variables, probability distributions, generating functions, and hypothesis testing. It also explores laws of large numbers, probability inequalities, and central limit theorems for statistical analysis and decision-making.

Outline syllabus:

UNIT1	**Descriptive Statistics and Probability**	CO Mapping
A	Representation of data (measures of central tendency).	CO1
B	Dispersion & other characteristics of data (mean deviation, variance, quartiles, Skewness and Kurtosis, Moments).	CO1
C	Classes of Sets, Fields, sigma-fields, minimal sigma-field, Borel field	CO1
UNIT 2	**Probability: Basic Concepts and Conditional Probability**	
A	Probability space, Basic terminologies and theorems on probability, theorem of total probability, theorems on compound probability	CO2
B	Independence of events, conditional probability	CO2
C	Bayes' Theorem and its applications	CO2
UNIT 3	**Random Variables and Probability Functions**	
A	Random Variable and its properties, mathematical expectation and inequalities involving random variables viz. Markov's, Holder's, Minkowski's and Jenson's Inequalities	CO3
B	PDF, PMF, Distribution function	CO3
C	Bivariate random variables, Marginal and conditional distributions	CO3, CO4
UNIT 4	**Generating Functions and Hypothesis**	
A	Generating functions, probability generating function, moment generating function characteristic functions,	CO3, CO5
B	factorial moment generating functions, Uniqueness theorem.	CO5,CO6
C	Hypothesis testing, Type I and II error, Level of Significance, power of test, Large and small sample test.	CO5,CO6
UNIT 5	**The Laws of Large Numbers, Inequalities and Central limit Theorem**	

A	Law of large numbers, Chebychev's and Khinchin's weak law of large numbers, Kolmogorov's theorem, Strong law of large numbers.			CO5,CO6
B	Central limit theorem, De-Moivre's Laplace central limit theorem.			CO5,CO6
C	Statement of Lindeberg- Feller's central limit theorem.			CO5,CO6
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		25%	25%	50%
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics". Sultan Chand & sons.		
	Other references	1.Ash, Robert B. (2000). Probability and Measure Theory, Second Edition, Academic Press, New York. 2. Feller, W. (1985). Introduction to Probability Theory and its Applications, Wiley Eastern, New Delhi 3. Bhatt, B.R. (1999). Modern Probability Theory, 3rd Edition, New Age International Publishers. 4. A. K. Md. Ehsanes Saleh and Vijay K. Rohatgi (2010) An Introduction to Probability and STATistics, Wiley India Pvt. Ltd.		

COURSE OUTCOMES – PROGRAMMEME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4704.1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**
STT4704.2	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**2**
STT4704.3	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
STT4704.4	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**
STT4704.5	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**
STT4704.6	**3**	**2**	**1**	**3**	**2**	**2**	**2**	**1**	**2**

School: SSES		**Batch: 2025-29**
Program: B.Sc. (Hons. /Hons. With research)		**Academic Year: 2028**
Branch: Data Science & Analytics		**Semester: VII**
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: SSES		**Batch: 2025-29**	
Programme: B.Sc. Hons. With Research		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VII**	
1	Course Code	**DAR4757**	
2	Course Title	Research Project- I	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	Project	
5	Course Objective	• Develop foundational research skills in identifying, formulating, and planning a mathematical, statistical and data science related research problem. • Strengthen initial academic writing and literature review skills.	
6	Course Outcomes	CO1: Identify a relevant research problem in data science and formulate clear research objectives. (K2, K4) CO2: Conduct a preliminary literature review and establish the basic theoretical framework. (K4, K5) CO3: Develop a basic proposal and timeline for the full dissertation. (K5) CO4**:** Develop effective project organizational skills. (K5) CO5. Discuss the ethical dimensions of your research and obtain appropriate ethical approval if needed. (K5) CO6. Plan a research article of the findings in an	

		appropriate manner. (K6)	
7	Course Description	This course introduces students to the research process through identification of a research topic, preliminary literature review, and proposal writing. It lays the foundation for advanced research in the subsequent semester.	
8	Outline syllabus		CO Achievement
	Unit 1	**Introduction to Research and Problem Identification** • Understanding research in statistics and data science • Identifying potential problems • Formulating objectives and scope	**CO1**
	Unit 2	**Literature Review and Theoretical Orientation** Techniques for literature search • Review and synthesis of previous work • Conceptual framework formation	**CO1, CO2**
	Unit 3	**Proposal Development** Structuring a research proposal • Methodology outline • Planning and timeline	**CO2, CO3**
	Unit 4	**Data Collection and Analysis** Execute data collection strategies as per the research design, where applicable. Employ advanced and appropriate statistical and data science techniques for thorough data analysis Interpret and contextualize the analytical results with respect to the research questions and the established theoretical framework.	**CO3, CO4**
	Unit 5	**Dissertation Writing and Defense** □ Structuring and writing the Research paper □ Adhering to academic writing standards and citation styles □ Preparing for and delivering the dissertation defense	**CO5,CO6**
	Mode of examination	Jury/Practical/Viva	
	Weightage Distribution	CA: 30% / CE: 30% / ETE: 40%	
	Text book/s*	-	

	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAR4757.1	3	3	2	2	2	3	2	3	3
DAR4757.2	2	3	3	2	3	2	3	3	2
DAR4757.3	2	3	2	2	3	3	3	3	3
DAR4757.4	2	3	2	2	2	3	2	3	2
DAR4757.5	2	2	2	3	3	3	3	3	3
DAR4757.6	2	2	2	3	3	3	3	3	3

OR
SEMESTER-VIII

School: SSES		**Batch: 2025-29**
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**
Branch: Data Science & Analytics		**Semester: VIII**
1	Course Code	**MDA117**
2	Course Title	**Computational Intelligence**
3	Credits	4

4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	To provide a strong foundation on fundamental concepts in Computational Intelligence. To enable Problem-solving through various searching techniques.	
6	Course Outcomes	CO1: Provide a basic exposition to the goals and methods of Computational Intelligence. CO2: Study of the design of intelligent computational techniques. CO3: Apply the Intelligent techniques for problem solving CO4: Improve problem solving skills using the acquired knowledge in the areas of reasoning, natural language understanding, computer vision, automatic programming and machine learning. CO5: Learn about the advance concept of AI CO6: Explain computable functions, predicates, forward and backward reasoning	
7	Course Description	To apply these techniques in applications which involve perception, reasoning and learning. To apply Computational Intelligence techniques for information retrieval. To apply Computational Intelligence techniques primarily for machine learning.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Introduction to Artificial Intelligence-Search-Heuristic	CO1,
	B	Search A* algorithm Game Playing Alpha Beta Pruning Expert systems	CO1,
	C	Inference Rules Forward Chaining and Backward Chaining Genetic Algorithms	CO1,
	Unit 2		
	A	Proposition Logic First Order Predicate Logic Unification Forward Chaining	CO2
	B	Backward Chaining Resolution Knowledge Representation Ontological Engineering Categories and Objects	CO2
	C	Event Mental Events and Mental Objects Reasoning Systems for Categories Reasoning with Default Information Prolog Programming.	CO3
	Unit 3		
	A	Non-monotonic reasoning-Fuzzy	CO4
	B	Logic Fuzzy rules fuzzy inference Temporal Logic	CO4
	C	Temporal Reasoning Neural Networks Neuro Fuzzy Inference.	CO4
	Unit 4		
	A	Probability basics - Bayes Rule and its Applications Bayesian Networks Exact and Approximate Inference in Bayesian Networks Hidden Markov Models Forms of Learning	CO5
	B	Supervised Learning - Learning Decision Trees – Regression and	CO5

		Classification with Linear Models - Artificial Neural Networks –	
	C	Nonparametric Models Support Vector Machines Statistical Learning, Learning with Complete Data Learning with Hidden Variables- The EM Algorithm Reinforcement Learning.	CO5
	Unit 5		
	A	Natural language processing-Morphological Analysis Syntax analysis	CO6
	B	Semantic Analysis All applications Language Models Information Retrieval Information	CO6
	C	Extraction Machine Translation Machine Learning Symbol Based Machine Learning: Connectionist Machine Learning.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ESE:75%	
	Text book/s*	1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach‖, Third Edition, Pearson Education / Prentice Hall of India. 2. Elaine Rich and Kevin Knight, Artificial Intelligence‖, Third Edition, Tata McGraw- Hill.	
	Other References	1. Patrick H. Winston. "Artificial Intelligence", Third edition, Pearson Edition. 2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems‖, PHI.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MDA117.1		2	1	2		1		3			3		1	1
MDA117.2		2	1	2		1		3			3		1	1
MDA117.3		2	1	2		1		3			3		1	1
MDA117.4		2	1	2		1		3			3		1	1
MDA117.5		2	1	2		1		3			3		1	1
MDA117.6		2	1	2		1		3			3		1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**3.0**		**1.0**	**1.0**

School: SSEs		**Batch: 2025-29**	
Programme: B.Sc. (Hons./ Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	**MDA112**	
2	Course Title	**Econometrics**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	DSE	
5	Course Objective	The objective of this course is to introduce regression analysis to students so that understand its applications in different fields of economics.	
6	Course Outcomes	CO1: Able to have concise knowledge of basic regression analysis of economic data and interpret and critically evaluate outcomes of empirical analysis. (K1, K2, K3). CO2: Analyze 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 advance methods for the implementation of econometric techniques also various functions for economic analysis and future forecasting. (K5, K6). CO6: Enable students to make use of econometric models in their academic 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			
	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	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 Goldfelf Quandt test.	CO3
	B	Autocorrelation, sources, and consequences.	CO3
	C	Autoregressive process tests for autocorrelation.	CO4
	Unit 4		
	A	Durbin Watson test. Asymptotic theory and regressors.	CO5
	B	Instrumental variable estimation, errors in variables.	CO5
	C	Simultaneous equations model, the problem of identification, a necessary and sufficient condition for the identifiability of parameters in a structural equation.	CO5
	Unit 5		
	A	Ordinary least squares, indirect least squares.	CO6
	B	Two-stage least square.	CO6
	C	Limited information maximum likelihood method.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	1.Gujrati, D.N. & Porter, D.C.: Basic Econometrics, 6th Edition. McGraw Hill. 2. Maddala, G.S. & Lahiri, K.: Introduction to Econometrics, 4th Edition. Wiley.	
	Other References	1. Greene, W.H.: Econometric Analysis, 7th Edition. Pearson. 2. Studenmund, A.H. &Johnson, B.K.: Using Econometrics: A Practical Guide, 7th Edition. Pearson.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MDA112.1		2	1	2		1		3			3	1	1	1
MDA112.2		2	1	2		1		3			3	1	1	1
MDA112.3		2	1	2		1		3			3	1	1	1
MDA112.4		2	1	2		1		3			3	1	1	1
MDA112.5		2	1	2		1		3			3	1	1	1
MDA112.6		2	1	2		1		3			3	1	1	1
Average		**2.0**	**1.0**	**2.0**		**1.0**		**3.0**			**3.0**	**1.0**	**1.0**	**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. Hons. /Hons.With Research		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	DAR4858	
2	Course Title	Research Project- II	
3	Credits	9	
4	Contact Hours (L-T-P)	0-0-18	
	Course Status	Project	
5	Course Objective	• Conduct detailed statistical and data science related research with emphasis on originality and rigor. • Strengthen academic writing and oral presentation skills through dissertation writing and defense.	
6	Course Outcomes	CO1: Demonstrate comprehensive understanding of the selected topic through data analysis and theoretical application. (K4) CO2: Apply data science and statistical tools and advanced methodologies to solve the research problem. (K5) CO3: Prepare a structured, well-documented dissertation. (K5, K6) CO4: Present and defend research outcomes effectively. (K6) CO5. Discuss the ethical dimensions of your research and obtain appropriate ethical approval if needed. (K5) CO6. Plan a research article of the findings in an appropriate manner. (K6)	
7	Course Description	This course involves conducting substantial and original research, data analysis, and producing a detailed dissertation. Students are expected to adhere to academic and ethical standards in research presentation and defense	
8	Outline syllabus		CO Achievement
	Unit 1	**Advanced Methodology & Data Collection** • Application of proposed research methods • Data acquisition (theoretical/computational/empirical)	**CO1**
	Unit 2	**Analysis and Interpretation** Applying appropriate analytical methods • Drawing conclusions and discussing implications	**CO1, CO2**
	Unit 3	**Dissertation Writing and Defense** • Academic writing practices • Structuring the final document • Oral presentation and defense	**CO2, CO3**

	Unit 4	**Data Collection and Analysis** • Implement data collection procedures in alignment with the proposed research methodology, where applicable. • Apply suitable and advanced mathematical tools for comprehensive data analysis. • Analyze and interpret findings in relation to the research objectives and the theoretical framework				**CO3, CO4**
	Unit 5	**Dissertation Writing and Defense** • Organize and compose a well-structured research dissertation or article. • Follow established academic conventions for writing, referencing, and citation styles. • Prepare for and effectively present the dissertation during the final defense session.				**CO5,CO6**
	Mode of examination	Jury/Practical/Viva				
	Weightage Distribution	CA	CE	ETE		
		30%	30%	40%		
	Text book/s*	-				
	Other References					

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAR4858.1	3	3	2	2	2	3	2	3	3
DAR4858.2	2	3	3	2	3	2	3	3	2
DAR4858.3	2	3	2	2	3	3	3	3	3
DAR4858.4	2	3	2	2	2	3	2	3	2
DAR4858.5	2	2	2	3	3	3	3	3	3
DAR4858.6	2	2	2	3	3	3	3	3	3