RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M.S. Ramaiah University of Applied Sciences

Programme Specifications

Of

B.Sc. (Hons) in Data Sciences and Analytics

Programme Code: 415

2022 onwards

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M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

M.S. Ramaiah University of Applied Sciences

School of Social Sciences

Department of Data Sciences and Analytics

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5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in

7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes

Faculty	Social Sciences
Department	Data Sciences and Analytics
Programme Code	415
Programme Name	B.Sc. (Hons) in Data Sciences and Analytics
Dean of the Faculty	
Head of the Department	

1. **Title of the Award:** B.Sc. (Hons) in Data Sciences and Analytics
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** School of Social Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** July 2022

7. **Date of Programme Approval by the Academic Council of MSRUAS:** 14-July-2022
8. **Next Review Date:** June 2026

9. **Programme Approving Regulating Body and Date of Approval: Academic Council of MSRUAS, 14-July-2020**
10. **Programme Accredited Body and Date of Accreditation: Not Applicable**
11. **Grade Awarded by the Accreditation Body: Not Applicable**
12. **Programme Accreditation Validity: Not Applicable**
13. **Programme Benchmark: Not Applicable**
14. **Rationale for the Programme**

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B.Sc. (Hons.) in Data Sciences and Analytics is an undergraduate honours degree programme designed to create motivated, energetic, thinking, and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, bank and commerce professions, trade markets experts and professionals like economic chief consultants, financial examiners, statistician, operations research analysts, credit analysts and so on.

The curriculum is outcome-based, and it imbibes required theoretical concepts and practical skills in the domain. Students develop application-oriented learning skills, critical, analytical thinking, and problem-solving abilities for a smooth transition from academic to the real-life work environment by undergoing this programme.

15. Programme Mission

B.Sc. (Hons.) in Data Sciences and Analytics is an undergraduate programme designed to create motivated, energetic, thinking and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, banking and commerce professions, trade markets experts and professionals like economic chief consultants, financial examiners, statisticians, operations research analysts, credit analysts, etc.

16. Graduate Attributes (GAs)

GA-1. Data Sciences and Analytics knowledge: Ability to apply knowledge of mathematics, science fundamentals to solve complex problems in Data Sciences.

GA-2. Problem Analysis: Ability to analyse Data Sciences problems, interpret data and arrive at meaningful conclusions involving mathematical inferences

GA-3. Design and Development of Solutions: Ability to design an Data Sciences and Data Analytics system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations

GA-4. Conduct Instigations of Complex Problems: Ability to understand and solve complex Data Sciences problems by conducting experimental investigations

GA-5. Modern Tool Usage: Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex economic activities

GA-6. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-7. Ethics: Ability to apply ethical principles to economic practices and professional responsibilities

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GA-8. Communication: Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-9. Life-long learning: Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

17. Programme Outcomes (POs)

B.Sc. (Hons) (Data Sciences and Analytics) graduates will be able to:

A. Apply the knowledge of Data Sciences and Data Analytics to the solution of complex societal problems.
B. Identify problems by closely examining the situations around them and think holistically about the phenomena and generate viable solutions to these problems. Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and evaluate them in terms of generic conventions.
C. Demonstrate ability to accommodate the views of others and present their own opinions and complex ideas, in written or oral form, in a clear and concise manner in group settings. Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies.
D. Infer scientific literature, build a sense of enquiry and be able to formulate, test, analyze, interpret, and establish hypothesis and research questions; and to identify and consult relevant sources to find answers.
E. Create new conceptual, theoretical, methodological innovations that integrate and transcend beyond discipline-specific approaches to address a common problem.
F. Perform independently and collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
G. Demonstrate empathetic social concern and equity centered national development and act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
H. Analyze the impact of the scientific solutions in societal and environmental contexts for sustainable development.
I. Demonstrate attitudes of being a life-long learner who passionately pursues self-determined goals in the broadest context of socio-technological changes.

18. Programme Goal

The programme goal is to produce graduates with critical, analytical and problem-solving skills, and ability to think independently, to pursue a career in Data Sciences and Analytics and allied areas.

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19. Programme Educational Objectives (PEOs)

The objectives of the B.Sc. (Hons) (Data Sciences and Analytics) programme are to:

A. Create a community of informed purveyors of knowledge geared towards academic excellence and increase the knowledge base and skill sets aimed at enhancing their professional competence.
B. Promote innovation and research by instilling a sense of independent and critical thinking with sensitivity to social needs.
C. Inculcate strong human values and social, interpersonal and leadership skills required for professional success in evolving global professional environments.

20. Programme Specific Outcomes (PSOs)

At the end of the B.Sc. (Hons) in Data Sciences and Analytics programme, the graduate will be able to:

A. Apply the knowledge of Data Sciences and Analytics to develop innovative and inclusive understanding to real-world issues.
B. Acquire the skills necessary to think critically and communicate effectively about Data Sciences and Analytics and allied domains.
C. PSO-3. Demonstrate the understanding of life-long learning and leadership qualities through professional development and strive for the betterment of organization, environment, and society.

Programme Structure:

Semester 1							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**
1	SSSF101A	Compulsory Foundation Course 1 (CFC 1)	3	1		4	100
2	SSSF102A	Compulsory Foundation Course 1 (CFC 2)	3	1		4	100
3	DSC101A	Maths for Data Science(CC)-1	4	1		5	100
4	DSC102A	Programming in R	4	1		5	100
5	DSC103A	Data Visualization	4	1		5	100

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6	DSU101A	Ability Enhancement Course 1	1	1		2	100
Total			**19**	**6**		**25**	**600**
Total number of contact hours per week			**25**				

Semester 2							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**
1	SSF103A	Compulsory Foundation Course 3 (CFF 3)	3	1		4	100
2	SSF104A	Compulsory Foundation Course 4 (CFC 4)	3	1		4	100
3	DSC104A	Inferential Statistics	4	1		5	100
4	DSC105A	Regression Techniques and Time Series Analysis	4	1		5	100
5	DSC106A	Programming in Python	4	1		5	100
6	DSO101A	Generic Elective 1	4	1		5	100
7	DSU101A	Skill Enhancement Course 1	1	1		2	100
Total			**23**	7		**30**	**700**
Total number of contact hours per week			**30**				

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Semester 3							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC201A	Multivariate Analysis	4	1		5	100
2	DSC202A	Data base Management Systems	4	1		5	100
3	DSC203A	Data Pre-processing	4	1		5	100
5	DSO201A	Generic Elective 2	4	1		5	100
6	DSU201A	Ability Enhancement Course 1	1	1		2	100
Total			**17**	**5**		**22**	**600**
Total number of contact hours per week			**22**				

Semester 4							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC204A	Operations Research & Optimisation Techniques ion Techniques (CC)	4	1		5	100
2	DSC205A	Data Warehousing & Mining (CC)	4	1		5	100
3	DSC206A	Artificial Intelligence (CC)	4	1		5	100
4	DSO202A	Generic Elective-3	4	1		5	100
5	DSU202A	Skill Enhancement Course – 2 (SEC-2)	1	1		2	100
		Total	**17**	**5**		**22**	**500**
Total number of contact hours per week			22				
Note: Students must choose one DSE out of three DSEs							

Semester 5							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC301A	Machine Learning (CC)	3	1	2	5	100
2	DSC302A	Big Data (CC)	4	1		5	100
3	DSE301A	Advanced Time Series and forecasting	3	1	2	5	100
4	DSE302A	Introduction to Computational Social Sciences (DSE) (Track 2)	4	1		5	100

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5	DSO301A	Open Elective-1 (SSS)	4	1		5	100
		Total	**20**	**5**		**25**	**500**
Total number of contact hours per week			25				
Note: Students must choose three DSE out of four DSEs							

Semester 6							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**
1	DSC303A	Dissertation/Project (CC)			12	6	100
2	DSE303A	Computing for Data Sciences (DSE) (Track 1)	4	1		5	100
3	DSE304A	Risk Management (DSE) (Track 2)	4	1		5	100
4	DSO301A	Open Elective-2 (SSS)	4	1		5	100
		Total	**24**	**3**		**21**	**400**
Total number of contact hours per week							

Note: Students must choose one DSE out of three DSEs

Semester 7							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**
1	DSE401A	Cloud Computing (DSE) (Tack 1)	4	1		5	100
2	DSE403A	Advanced Machine Learning (DSE) (Tack 1)	4	1		5	100
3	DSE404A	Applied Social Network Analysis with Python (DSE) (Tack 2)	4	1		5	100
4	DSE405A	Applications in Economics (DSE) (Tack 2)	4	1		5	100
5	DSO401A	Open Elective-3 (SSS)	4	1		5	100
		Total	**28**	**5**		**35**	**700**
Total number of contact hours per week			35				

Semester 8							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**

1	DSI401A	Capstone/project/ Internship	12	6	100
		Total	**12**	**6**	**100**
Total number of contact hours per week			12		

Students must choose one DSE out of two DSEs

	Professional Core Electives (PCE): NA						

Open Elective Courses

A number of Open Elective Courses from School of Social Sciences are offered as mentioned in the University's website. Students can choose the Open Electives on their own choice.

22.1 Innovation Courses in Lieu of Open Elective Courses

NA

1. **Course Delivery:** As per the Timetable

2. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project 11.Exhibitions 12.Technical Festivals

3. Assessment and Grading

For the courses having 100% theory - Total Marks: 100

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There are two components-Component-1 and Component-2
Component-1 (CE) carries a weight of 50% and Component -2 (SEE) carries a weight of 50%

Component-1 (CE): 50 % Weight

The course leader will indicate the mode of assessment in consultation and approval of the respective HoD and the faculty Dean, before commencement of the semester. The template for weightage of CE and SEE in percentages for each course is indicated in Table below.

CO No.	Course Outcomes	Continuous Assessment , 50% Marks			Semester End Examination, 50% Marks
		CE-1, x%	CE-2, Y%	CE-3, Z %	
1	CO -1				
2	CO -2				
3	CO -3				
4	CO -4				
5	CO -5				

CE – can be from any combination of the following:
Assignments, term Tests, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, others, if any.

Component -2 (SEE): 50 % weight.

A 3 hour duration semester end examination will be conducted for a maximum of 100 marks and will be reduced to 50 % weight

A student is required to score a minimum of 40 % marks in semester end examination and 40 % overall in each theory course

1. For Laboratory/Practical Courses - Total Marks: 50

Component -1(CE): Conduction of Laboratory Exercises and Submission of Report: 50% weight
Component -2:(SEE): Semester End Laboratory Examination: 50% weight
A 3 hour duration semester end examination will be conducted for a maximum of 50 marks.

The course leader will indicate the mode of assessment in consultation and approval of the respective HoD and the faculty Dean, before the commencement of the semester.

The template for weightage of CE and SEE in percentages for each course is indicated in the Table below.

CO No.	Course Outcomes	Continuous Assessment , 50% Marks				Semester End
		Conduction	Lab Record	Viva %	Lab est	

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		of Lab %	Submission %		(%)	Examination, 50% Marks
1	CO -1					
2	CO -2					
3	CO -3					
4	CO -4					

A student is required to score a minimum of 40 % marks in semester end examination and 40% marks overall in each laboratory course.

2. For courses with a combination of theory and laboratory :

Total Marks: 100

There are two components-Component-1 and Component-2
Component-1 (CE) carries a weight of 50% and Component -2 (SEE) carries a weight of 50%.

Component -1 (CE): 50% Weight

The course leader will indicate the mode of assessment in consultation and approval of the respective HoD and the faculty Dean, before the commencement of the semester.

The template for weightage of CE and SEE in percentages for each course is indicated in the Table below.

CO No.	Course Outcomes	Continuous Assessment, 50% Marks			Semester End Examination, 50% Weightage 50 Marks
		CE-1, x%	CE-2, Y%	CE-3, Lab Z %	
1	CO -1				
2	CO -2				
3	CO -3				
4	CO -4				
5	CO -5				

CE – can be from any combination of the following:
Assignments, term Tests, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, others, if any.

A 3 hour duration semester end examination will be conducted for a maximum of 100 marks and will be reduced to 50 % weight

A student is required to score a minimum of 40 % marks in semester end examination and 40 % overall in each theory course

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4. Minor Programme

NA

5. Student Support for Learning

11. Course Notes
12. Reference Books in the Library
13. Magazines and Journals
14. Internet Facility
15. Computing Facility
16. Laboratory Facility
17. Workshop Facility
18. Staff Support
19. Lounges for Discussions
20. Any other support that enhances their learning

6. Quality Control Measures

21. Review of Course Notes
22. Review of Question Papers and Assignment Questions
23. Student Feedback
24. Moderation of Assessed Work
25. Opportunities for students to see their assessed work
26. Review by external examiners and external examiners reports
27. Staff Student Consultative Committee meetings
28. Student exit feedback
29. Subject Assessment Board (SAB)
30. Programme Assessment Board (PAB)

1. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
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27. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
1	Compulsory Foundation Course 1 (CFC 1)	3		2			1				3	1	2
1	Compulsory Foundation Course 1 (CFC 2)	3		2				1		1	3	1	2
1	Linear Algebra (CC)	3		2			1				3	1	2
1	Programming in R Lab (CC)	3	2						1		3	2	1
1	Data Visualization (CC)			2		3			2	1	2	3	1
1	Ability Enhancement Course 1	2	3							1	3	2	1
2	Compulsory Foundation Course 3 (CFF 3)	3		2			1				3	1	2
2	Compulsory Foundation Course 4 (CFC 4)	3	2							1	3	2	1
2	Inferential Statistics (CC)	3		2			2				2	3	1
2	Regression Techniques and Time Series Analysis (CC)	2		3		3	3		2		2	3	1
2	Python Programming Lab (CC)					3	2			2	2	3	1
2	Generic Elective 1	3		2			1				3	1	2
2	Skill Enhancement Course – 1 (SEC-1)			1		2			3		3	2	1
3	Multivariate Analysis (CC)	3		2			1				3	1	2
3	Database Management Systems (CC)	2		3			1				2	3	1
3	Data Pre-processing (CC)			3	2			1			2	3	1
3	Generic Elective 2	3		2			1				3	1	2
3	Ability Enhancement Course 1		3	2			1				3	2	1
4	Operations Research & Optimisation Techniques ion Techniques (CC)	2					1		3		3	2	1
4	Data Warehousing & Mining (CC)		3	2						1	3	1	2
4	Artificial Intelligence (CC)	3		2			1				3	1	2
4	Generic Elective-3		3	1			2				3	2	1
4	Skill Enhancement Course – 2 (SEC-2)			3				1	2		2	3	1
5	Machine Learning (CC)	3					2			1	2	3	1

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5	Big Data (CC)	3		1					2		3	1	2
5	Deep Learning (DSE) (Track 1)	3		2			2				2	3	1
5	Introduction to Computational Social Sciences (DSE) (Track 2)		3	1			2				3	2	1
5	Open Elective-1 (SSS)		3				1	2		2	3	1	
6	Dissertation/Project (CC)				3	3			2		3	1	2
6	Computing for Data Sciences (DSE) (Track 1)	2	3							1	3	2	1
6	Risk Management (DSE) (Track 2)	3		2			1				3	1	2
6	Open Elective-2 (SSS)	3	2							1	3	2	1
7	Cloud Computing (DSE) (Tack 1)		3	1			2				3	2	1
7	Advanced Machine Learning (DSE) (Tack 1)	2		3		3	3		2		2	3	1
7	Applied Social Network Analysis with Python (DSE) (Tack 2)					3	2			2	2	3	1
7	Applications in Economics (DSE) (Tack 2)	3		2			1				3	1	2
7	Open Elective-3 (SSS)	3		2			1				3	1	2
8	Capstone/project/ Internship				3	3			2		3	1	2

28. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

29. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

30. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

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Course Specifications

B.SC. (Hons) in Data Sciences and Analytics

Programme Code: 415

School of Social Sciences
2022 onwards

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SEMESTER 1

Course Specifications: Math for Data Science

Course Title	Math for Data Science
Course Code	DSC101A
Course Type	Core

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Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

The objective of this course in to introduce to the concept of vector, graphical representation of vector operation, matrix operations, eigen value and eigen vectors, finding solution for linear equations. Finally, they will be introduced with calculus covering intuition for limit, continuity and calculating first and second order derivative.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3.Course Outcomes (COs)

After the successful completion of this course, the student will be able to:
CO-1. Familiarize with the concept of vectors, theory of matrices and tools for solving system of linear equations
CO-2. Impart knowledge on Eigen values and Eigen vectors.
CO-3. Teach basic concepts of vector spaces and their properties.
CO-4. Explain the concepts of Limit, Continuity and Derivative

4. Course Contents

Unit 1: Vectors and Matrices
Concept of vector, vector operations, graphical representation of vector operation. Introduction to Matrices and Determinants, Properties of Determinant, Cramer's rule, inverse of a matrix, rank of a matrix, hermitian and unitary matrices, eigen values and eigen vectors.

Unit 2: System of Linear Equations
Concept of linear relation in linear equation, solution of linear equations, solving system of linear equations, Gaussian elimination method, Echelon and Row-reduced Echelon Form of a matrix, Linear Transformation, linear dependence and independence.

Unit 3: Vector Space
Vector space, linear combination of vectors, linear span, basis and dimension. linear

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transformations-null space, Row and Column Space. Inner Product Spaces, examples of inner product spaces, Cauchy-schwarz's inequality, orthogonality, orthogonal sets.

Unit 4: Calculus

Concept of Tangent and Secant Line, Calculating slope, positive and negative slope, calculating limit of function, Continuous Function. Calculating derivative and equation of a tangent line, derivative of trigonometric functions.

5. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6.Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		05
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

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5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

7.Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8.Achieving COs

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The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Essential Reading

1. Gilbert Strang ,Introduction to linear algebra, 5/e, Wellesley-Cambridge Press, 2016.
2. Seymour Lipchutz,Marc Lipson,Linear Algebra,Schaum's Outline,4/e,McGraw-Hill Education, 2008
3. Peter V. O'Neil, Advanced Engineering Mathematics, 7/e, Cengage, 2012.
4. B. S. Grewal, Higher Engineering Mathematics,44/e, Khanna Publishers, 1965.
5. Michael. D. Greenberg, Advanced Engineering Mathematics, 2/e, Pearson,2002.

10.Course Organization

Course Code	DSC101A		
Course Title	Linear Algebra		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date		10/07/2021	
Next Course Specifications Review Date			

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Course Title	Programing in R
Course Code	DSC102A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

The goal of the course is to give the students an introduction to programming through R and teach them how to conduct data analysis through R. After this course, the students will be familiar with basic components of programming such as loops, conditions and functions, and have a working knowledge data wrangling and visualization using the tidyverse ecosystem.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1. Understand the fundamental syntax,variety of data formats of R through demonstrations, exercises and writing R script in RStudio
CO-2. Get familiarise with the concepts data types, data structures, iteration, control flow structures, functions, and operators by writing R programs and through examples
CO-3. Use R to read files of different formats, prepare or clean data for analysis, Learn to perform descriptive statistics in R
CO-4. Learn data visualization through ggplot2 package

3. *Course Contents*

Unit 1: Introduction

Introduction to R studio and R, Working directories, Variables, Atomic data types, Conditions and Loops, Functions, Default arguments, Packages in R, Basics of R Markdown

Unit 2: Data Structures

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Vectors, Matrices, Lists, Data Frames, Dimensionality of data, indexing data structures, String operations using stringr package

Unit 3: Data Analysis
Tidyverse Package, Delimited files, reading and writing delimited files, Data transformation using dplyr verbs, frequency tables

Unit 4: Data Visualization in R
Scatter Plots, Box Plots, bar plot, Histograms, Use of different aesthetics and geometries in ggplot2 library, improve data visualizations using theme, scale and facets, Create reference variables using appropriate scope.

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	3	2						1		3	2	1
CO-2	3	2						1		3	2	1
CO-3	3	2						1		3	2	1
CO-4	3	2						1		3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	35	
Practical Work		
1. Course Laboratory	00	

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2. Computer Laboratory	00	15
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming HospitalSessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				

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The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

7. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

References:

1. Venables W.N., Smith D.M. et al. (2022), An Introduction to R. CRAN
2. Wickham, H. & Grolemund, G. (2018). R for Data Science. O'Reilly
3. Peng R.D. (2022), R Programming for Data Science. Leanpub

Required software

1. R: http://www.r-project.org/
2. RStudio (additional libraries required): http://www.rstudio.com/

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8. *Course Organization*

Course Code	DSC102A	
Course Title	Programing in R	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

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Course Specifications: Data Visualization

Course Title	Data Visualization
Course Code	DSC103A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

The purpose of this course is to introduce the importance of Data visualization to convey the insight of any data. They will be introduced to EDA through visualization, applying important aspects of data aggregation and filtering through Tableau and Power Bi software.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1. Design and create data visualizations and Conduct exploratory data analysis using visualization.

CO-2. Craft visual presentations of data for effective communication.

CO-3. Use knowledge of perception and cognition to evaluate visualization design alternatives and Design and evaluate color palettes for a visualization based on principles of perception.

CO-4. Apply data transformations such as aggregation and filtering for visualization and dentify opportunities for the application of data visualization in various domains.

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CO-5. Critique existing visualizations based on data visualization theory and principles.

3. Course Contents

Unit 1: Introduction to Tableau/Power Bi/Excel

Course introduction, Datavizualization best practices, Getting started with Tableau Desktop, Connecting to the tutorial dataset, Creating the first charts, Filtering, and sorting data.

Unit 2: Working on Charts

Creating common visualizations (bar charts, line charts, etc.), Assembling a dashboard layout, Using dashboard filters

Unit 3: Data Transformation

Datavizualization best practices, Creating simple calculations in Tableau, Using table calculations

Unit 4: Interactions

Interactivity with text and visual tooltips, Interactivity with actions (filter, highlight, URL), Drilldown between dashboards

Unit 5: Advanced Visualizations

Data vizualization best practices, Creating more advanced chart types, Using multiple source tables

Unit 6: Data Storytelling

Intro to data storytelling, Creating a data story in Tableau, Overview of the Tableau ecosystem, Further learning opportunities

4. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1								1		3	2	1
CO-2		2						1		3	2	1
CO-3		2	2		3			1		3	2	1
CO-4			2		3			1	1	3	2	1

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CO-5	3	2						1		3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	35	35
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Hospital Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

5. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The

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procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	100 Marks
Maximum Marks ▶	50	25	25	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

6. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--

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11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Designing Data Visualizations: Representing Informational Relationships Book by Julie Steele and Noah Iliinsky

Technical Requirements:

1. System requirements are listed hereunder Tableau Desktop and Tableau Prep: https://www.tableau.com/products/techspecs
2. The latest version of Tableau Desktop, as well as Tableau Prep, should be downloaded and installed from here: https://www.tableau.com/tft/activation

Course Organization

Course Code	DSC103A		
Course Title	Data Visualization		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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SEMESTER 2

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Course Specifications: Python Programming

Course Title	Python Programming
Course Code	DSC104A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

The objective of the course is to familiarize the students about the various concepts in data types, variable, Control Flow. Writing functions, basic concepts of Data Structure. Students will learn to code in Jupyter Notebook. They will learn to work on Numpy and Pandas packages.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1. Understand the basis of Algorithms, data types, variable and function.
CO-2. Concept of Data Structure, write function.
CO-3. Understanding the concept of Numerical Python(NumPy), basic indexing, slicing of array.
CO-4. Getting introduce to Pandas objects and Essential functionalities.

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CO-5. Getting introduce to matplotlib

3. *Course Contents*

Unit 1: Python language Basics:
Basic concepts variable, data type. Different available IDEs, Installing Jupyter Notebook, IPython basics. Control loop- if-else.

Unit 2: Built-in Data Structure, Functions:
Data Structures and Sequences – List, Tuple, Set, Dictionary. Functions : local and Global scope, creating user-defined functions, Generators, Lambda Functions.

Unit 3: NumPy Basics:
Concept of ndarray, Data Types for ndarrays, Function;

Unit 4: Introduction to Pandas: Pandas objects : Series, DataFrame, Essential Functionalities: head, shape, describe, reindexing.

Unit 5: Data Visualization with matplotlib: Use of matplotlib for Figures, Subplots, different aspects of plotting aesthetics : Ticks, Labels, Legends, Saving plots to files.

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	2				3	2		2		2	3	1
CO-2	2				3	3		2		2	3	1
CO-3		1			3	3		2		2	3	1
CO-4					3	3		2		2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

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3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC_1, SC_2 or SC_3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC_1**	**SC_2**	**SC_3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				

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CO-3				
CO-4				
CO-5				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

1. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Essential Reading

1. Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython by **Wes McKinney (OŔielly Publication)**
2. Practical Time Series Analysis: Prediction with Statistics and Machine Learning by **Aileen Nielsen (OŔielly Publication)**

10. Course Organization

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Course Code	DSC106A		
Course Title	Python Programming		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Regression Techniques and Time Series Analysis

Course Title	Regression Techniques and Time Series Analysis
Course Code	DSC105A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

The benefit of simplicity, parsimony and interpretability offered by regression models (and their close generalizations) should make them a first tool of choice for any practical problem. Regression models are the workhorse of data science. They are the most well-described, practical, and theoretically understood models in statistics. This course intends to help students understand the basic premises of regression techniques thereby equipping them to apply the course content to basic and advanced problems later.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

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After the successful completion of this course, the student will be able to:

CO-1: Understand the concept of a simple linear regression model and properties of model parameters;
CO-2: Understand the development of modern statistical models and the relationships of these models;
CO-3: Apply various linear models to address research questions and fit into different data structure;
CO-4: Help the students learn basic analysis of time series data; learn basic concepts in time series regression; learn forecasting based on baseline model, auto-regressive and moving average process; visualization, and analysis of time series data.

3. Course Contents

Unit 1: The Nature of Regression Analysis: Historical Origin of the Term Regression; The Modern Interpretation of Regression; Statistical versus Deterministic Relationships; Regression versus Causation; Regression versus Correlation

Unit 2: Two-Variable Regression Analysis: Some Basic Ideas: The Concept of Population Regression Function (PRF); The Meaning of the Term Linear; Stochastic Specification of PRF; The Significance of the Stochastic Disturbance Term; The Sample Regression Function (SRF).

Unit 3: Two-Variable Regression Model: The Problem of Estimation: The Method of Ordinary Least Squares; The Classical Linear Regression Model; Properties of Least-Squares Estimators; The Gauss–Markov Theorem

Unit 4: Classical Normal Linear Regression Model (CNLRM): The Normality Assumption for UI; Properties of OLS Estimators under the Normality Assumption

Unit 5: Two-Variable Regression: Interval Estimation and Hypothesis Testing: Interval Estimation: Some Basic Ideas; Confidence Intervals for Regression; Hypothesis Testing
Unit 6: **Time-series (TS) analysis**: Forecasting, Components of TS, Baseline model and Moving Average and Auto-regressive Model in TS, Measure of Forecast Accuracy

4. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3

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CO-1	2		3		3	3		2		2	3	1
CO-2	2		3		3	3		2		2	3	1
CO-3	2		3		3	3		2		2	3	1
CO-4	2		3		3	3		2		2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	15	15
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations	00	
Total Duration in Hours		**75**

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6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	**Curriculum and Capabilities Skills**	**How imparted during the course**
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study

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9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Essential Reading

1. Kenney and Keeping. Mathematical Statistics. Part 1 & Part II, Chapman and Hall.
2. Croxton, Cowden and Klein. Applied Statistics, Prentice Hall.
3. Hogg and Craig. Introduction to Mathematical Statistics, Prentice Hall.
4. Goon, Gupta and Dasgupta. Fundamentals of Statistics, The World Press.
5. N G Das, Statistical Methods, McGraw Hill Education

8. *Course Organization*

Course Code	DSC105A		
Course Title	Regression Techniques and Time Series Analysis		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Inferential Statistics

Course Title	Inferential Statistics
Course Code	DSC104A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

Introduce the basic elements of statistical methods in the estimation of population parameters. The subject helps students to familiarise themselves with various methods of hypothesis testing and their properties. Applications in business will be emphasized by using practical examples to illustrate the principles and methods.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

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2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1: Identify and analyze critical features of data sets on real-life business situations

CO-2: Understand and apply statistical reasoning to the concept of parameter estimation on mean, proportion, and variance

CO-3: Acquire techniques to calculate problems on point and interval estimation

CO-4: Solve concepts on Testing of Hypotheses both on large and small samples
CO-5: Hypothesize advanced statistical techniques for modeling by exploring practical situations

3. *Course Contents*

Unit 1: Sampling Distributions
Population and random samples; The Central Limit Theorem; Sampling distributions related to sample means, sample proportions, and sample variances.

Unit 2: Useful Distributions in Statistical Inference

Definitions and properties of normal, t, F, and chi-square distributions; Familiarisation with the relationships between these distributions and the use of corresponding tables.

Unit 3: Estimation of Parameters

Concepts of point estimator, unbiasedness and efficiency; Concepts of confidence interval; Point and interval estimates of a mean and the difference between two means, proportion and the difference between two proportions, variance and the ratio of two variances; Sample size determination; Illustrative examples of their applications in business.

Unit 4: Test of Hypotheses

Statistical hypotheses and their tests; Type I and type II errors; Onesided and two-sided tests; Tests of significance; Levels of significance; Test statistics; Critical regions; p-values; Tests for an assumed mean, the difference between two means, an assumed proportion, the difference between two proportions, an assumed variance, and the ratio of two variances;

Illustrations of their applications in business; The use of chi-square tests for goodness of fit and independence; Contingency tables; Illustrative examples of their applications in business.

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Unit 5: Nonparametric Tests

Nonparametric tests: the sign test, the signed-rank test, the rank-sum test, the Kolmogorov-Smirnov test, and then the run-test

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	2		3			2				2	3	1
CO-2	2		3			2				2	3	1
CO-3	2		3			2				2	3	1
CO-4	2		3			2				2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	15	15
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

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Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

7. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. Dunlop, Tamhane, Statistics, and Data Analysis: From Elementary to Intermediate, 1st edition, Pearson, 2000
2. William M.K. Trochim, Research Methods Knowledge Base
3. Sprinthall, R. C. Basic Statistical Analysis. Publisher: Allyn and Bacon
4. Howell D. C. (2007), Statistical Methods for Psychology (6th Ed.). Publisher: Thomson/Wadsworth.

8. *Course Organization*

Course Code	DSC105A		
Course Title	Inferential Statistics		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			

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Next Course Specifications Review Date	

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SEMESTER 3

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Course Specifications: Multivariate Analysis

Course Title	Multivariate Analysis
Course Code	DSC201A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

Multivariate Analysis is a statistical technique used to analyze relationships among multiple variables simultaneously. This course delves into advanced statistical methods, exploring how various variables interact and influence each other within a dataset. Students will learn techniques such as multivariate regression, factor analysis, and multivariate analysis of variance

2. Course Size and Credits:

Number of Credits	05

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Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1 . Learn to develop an in-depth understanding of the Multivariate models, methods and techniques
CO-2. Demonstrate the knowledge and skill of multivariate normal distributions, related probability
distributions and their applications
CO-3. Examine the relationships between dependent and independent variables of multivariate models,
estimate the parameters and fit a model.
CO-4. Perform, handle and manipulate the analysis of logistic regression.

3. *Course Contents*

Unit 1: Introduction to Multivariate Data Analysis
Understanding of multivariate data and their diagrammatic representation. Exploratory multivariate data analysis, mean vector, covariance and correlation matrix, graphical representation of means, variances, co-variances, correlations of linear transforms, ANOVA model

Unit 2: Multivariate Normal Distribution
Introduction to multivariate distribution, probability density function and moment generating function of multivariate normal distribution, singular normal distributions, distribution of linear and quadratic form of normal variables, marginal and conditional distributions. Random sampling from multivariate normal distributions. Goodness of fit of multivariate normal distribution.

Unit 3: Multivariate Linear Model and Analysis of Variance and Covariance
Maximum likelihood estimation of parameters, tests of linear hypothesis, distribution of partial and multiple correlation coefficients and regression coefficients. Multivariate linear regression multivariate analysis of variance of one- and two-way classification data (only Likelihood Ratio test)

Unit 4: Logistic Regression

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Regression with a binary dependent variable, representation of the binary dependent variable, estimating the logistic regression model, assessing the goodness of fit of the estimation model, testing for significance of the coefficients, interpreting the coefficients.

4.Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

1. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	00
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	15	15
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

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7.Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

8. Course Resources

1. Hardly W.K. and Simor L., Applied Multivariate Statistical Analysis, 4 th Edition, Springer-Verlag, 2015.
2. Joseph F. Hair, Jr., William C. Black, Barry J. Babin, Rolph E. Anderson and Ronald L. Tatham, Multivariate Data Analysis, 7 th Edition, Pearson Education India, 2014.
3. Rao, C. R. and Rao, M. M., Multivariate Statistics and Probability, Elsevier & Academic Press, 2014.
4. Basic Econometrics by Damodar N. Gujarati and Dawn C. Porter

9.Course Organization

Course Code	DSC201A

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Course Title	Multivariate Analysis		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Data Pre-processing

Course Title	Data Pre-processing
Course Code	DSC202A
Course Type	Core Theory

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Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

This course is designed to expose the students to the basic concepts of reading files of different formats, web scrapping, data cleaning and grouping of datasets. Pandas package is used through out the course.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1. To impart the knowledge and skill of handling structured and real-life unstructured data
CO-2. Familiarise with the tools(Pandas, Numpy, Scikit-learn etc.) to get insight of information hidden in data
CO-3. The basic understanding of Feature Engineering.
CO-4. Empowering students with tools and techniques used in data science for data cleaning and data wrangling.

3. *Course Contents*

Unit 1: Data Reading and Storage in different File formats
Understanding of Pandas Series and Dataframes, Reading and writing data in Text Format, working with delimited and Binary data Formats, Interacting with Web API

Unit 2: Data Cleaning and Preparation
Different strategies to deal with Missing Values, Data Transformation, Cleaning Text Data, Outlier Treatment and Removal

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4. Clinical Laboratory	00	00
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

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Unit 3: Data Wrangling and Data Aggregation
Working with Date and Time, Filtering DataSet, Combining and Merging Dataset, Reshaping and Pivoting, Use Groupby method to organize data

Unit 4: Feature Extraction
Dealing with Categorical Variable, missing value imputation, Feature Scaling

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1			1	2			1			3	2	1
CO-2			1	2			1			3	2	1
CO-3			1	2			1			3	2	1
CO-4			1	2			1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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7. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Course Resources

1. Python for Data Analysis (Data Wrangling with Pandas, NumPy, and Ipython) by Wes McKinney **(OŔielly Publication)**
2. https://www.python.org/
3. Python Cookbook by David Beazley and Brian K. Jones
4. https://numpy.org/
5. https://pandas.pydata.org/
6. https://scikit-learn.org/stable/
7. https://matplotlib.org/

9. *Course Organization*

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Course Code	DSC202A

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Course Title	Data Pre-processing		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Title	Database Management Systems
Course Code	DSC203A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

2. *Course Outcomes (COs)*

After the successful completion of this course, the student will be able to:

CO-1. Describe the concepts, design, and applications of database systems
CO-2. Explain the principles of data modeling, querying, storage, transactions, and optimization of database systems
CO-3. Analyze the schema and use appropriate normalization techniques for relational databases
CO-4. Develop queries using query languages for a given database system and Apply principles of database systems to model data and create queries
CO-5. Design and implement an efficient database system and interface it with a given application

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3. *Course Contents*

Unit 1 : Introduction to Database Systems:
Purpose of database systems, characteristics of database approaches, history of database applications, classification of DBMS, database users, architectures for DBMS, recent database applications, data models, schemas, data independence, database design, and implementation process.

Unit 2 Entity-Relationship Model:
E-R diagrams, entities, attributes, relationships, roles and constraints, Enhanced Entity-Relationship (EER) diagrams, subclasses and super classes, specialization, and generalization.

Unit 3 - Relational Data models: Relational schema, relational model constraints, keys, relational database design, relational algebra, relational calculus.

Unit- 4 Query Languages:
SQL- data definition and data types, query formulation, constraints in SQL, basic queries in SQL, complex queries in SQL, QBE, query processing, database programming - techniques and issues, embedded SQL, using JDBC, database stored procedures.

Unit-5 : Normalization for Relational Databases:
Functional dependency, normal forms, decomposition of a schema, multivalued dependencies, join dependencies, dependency preservation, inclusion dependencies.

Unit- 6: File Organization and Storage:
Basic file structure, RAID technology, hashing techniques, indexing structures, types of single-level ordered indexes, multi-level indexes, B+ trees.

Unit -7: Transaction Processing:
Transaction processing systems, transaction states, ACID properties, characterizing schedules, recoverability, and serializability of schedules, concurrency control, locking techniques, timestamp ordering, database recovery techniques, shadow pages, ARIES recovery algorithm, database security, and authorization.

Unit-8: Multidimensional Data Modeling:
Logical multidimensional data model, cubes, dimensions, measures, OLAP servers, ROLAP-fact and dimension tables, star and snowflake schemas.

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3

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CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	35	35
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

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6. *Course Assessment and Reassessment*

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. *Achieving COs*

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	**Curriculum and Capabilities Skills**	**How imparted during the course**
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--

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8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

A.Essential Reading

10. Course Organization

Course Code	DSC202A		
Course Title	Data Pre-processing		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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SEMESTER 4

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Course Specifications: Operations Research and Optimization Techniques

Course Title	Operations Research and Optimization Techniques
Course Code	DSC211A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

The course aims at building capabilities in the students for analysing different situations and

applying optimization techniques in the industrial/ business scenario involving limited

resources and finding the optimal solution within constraints.

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

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Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

1. Understand the overview of optimization techniques, concepts of decision variables,

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constraint surfaces and objective function., Formulate real-life problems with Linear Programming.

2. Solve the Linear Programming models using graphical, Algebraic and simplex methods.
3. Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms
4. Use of Ortools, Pyomo framework and different Solver to solve lpp

Course Contents

Unit 1: Introduction

Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study.

Characteristics and limitations of OR, models used in OR.

Unit 2: Linear Programming Problem (LPP)

Part I: Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as

L.P.P. Solutions to LPP by graphical method (Two Variables).

Part II: Simplex method, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP.

Solutions to L.P.P by Dual Simplex Method.

Unit 3: Transportation Problem

Formulation of transportation problem, types, initial basic feasible solution using North-

West Corner rule, Vogel's Approximation method. Optimality in Transportation problem

Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic, Logic programming.

Unit – 4 : Hands-on

Use of different framework and solvers to solve different lpp problems:

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- **Solvers**: CPLEX – Gurobi – GLPK – SCIP
- **Frameworks**: Pyomo – Or-Tools – PuLP – Pymoo
- **Same Packages and tools**: Geneticalgorithm – Pyswarm – Numpy – Pandas – MatplotLib – Spyder – Jupyter Notebook

Unit 5: Game Theory

Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

1. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		
1. Course Laboratory	00	

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2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	

4. Clinical Laboratory	00	00
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC_1, SC_2 or SC_3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC_1**	**SC_2**	**SC_3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				

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CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs
The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

1. "Operations Research: An Introduction" by Taha, Hamdy A.
2. "Introduction to Operations Research" by Hillier, Frederick S., and Lieberman, Gerald J.
3. "Optimization Methods for Large-Scale Machine Learning" by Léon Bottou, Frank E. Curtis, and Jorge Nocedal

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Course Code	DSC211A		
Course Title	Operations Research and Optimization Techniques		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Data Warehousing and Mining

Course Title	Data Warehousing and Mining
Course Code	DSC212A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

The course provides a comprehensive understanding of storing, managing, and analyzing large volumes of data efficiently. Students learn the principles of data warehousing architecture, focusing on designing and building data warehouses. The course delves into advanced techniques for data mining, covering algorithms for pattern recognition, clustering, and predictive modeling. Students gain hands-on experience in using tools like SQL Server, Oracle, and data mining software

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

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Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

1. Understand the need of designing Enterprise data warehouses.

2. Approach business problems analytically by identifying opportunities to drive business.

3. Compare and contrast, various methods for storing & retrieving data from different data sources/repository

4. Ascertain the application of data mining in various areas and pre-process the given data and visualize it for a given application or data exploration/mining task

5. Understand basic supervised learning methods and its applications and unsupervised learning methods and its applications.

Course Contents

Unit 1: Data Warehousing:

Introduction, Delivery Process, Data warehouse Architecture, Data Preprocessing: Data cleaning, Data Integration and transformation, Data reduction. Data warehouse Design: Data warehouse schema, Partitioning strategy Data warehouse Implementation, Data Marts, Meta Data.

Unit 2: OLAP Systems:

Basic concepts, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP. Introduction: Understanding ODS, ETL and ELT. Understanding the key differences between ETL and ETL and its various applications. Structured Query Language understanding from basic concepts to complex query generation.

Unit 3 Introduction to Data Mining:

Types of Data, Quality of data, Data Preprocessing, Similarity measures, Summary statistics, Data distributions, Basic data mining tasks. Challenges in Data Mining.

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Understanding CRISP-DM process model. Case study to based understanding of framing data science problems clearly based on Business Problems.

Unit 4 Supervised Learning:

Introduction to Decision Tree Based Classification algorithms and Linear Regressions Algorithm. Understanding the practical application of Supervised Classifier algorithm based on business case study.

Unit 5 Unsupervised Learning:

Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering. Case study-based approach to solve actual business problems from scratch to segments and persona generation. Profiling of customers based on segments created and improvement of segments over time.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

2. *Course Teaching and Learning Methods*

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	

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2. Demonstration using Physical Models / Systems	00	00
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	35	35
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	

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Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	100 Marks
Maximum Marks ▶	50	25	25	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs
The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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Books Recommended:

1. Pang – ningTan , Steinbach & Kumar, "Introduction to Data Mining", Pearson Edu, 2019.
2. Jaiwei Han, Micheline Kamber, "Data Mining : Concepts and Techniques", Morgan Kaufmann Publishers

Reference Books:

1. Margaret H. Dunham, "Data Mining : Introductory and Advanced topics", Pearson Edu., 2009.
2. Anahory& Murray, "Data Warehousing in the Real World", Pearson Edu., 2009.

Course Code	DSC212A		
Course Title	Data Warehousing and Mining		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Artificial Intelligence

Course Title	Artificial Intelligence
Course Code	DSC213A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

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Course Outcomes (COs)

The students should be able to:

· Apply the knowledge of Artificial Intelligence to write simple algorithm for agents.

· Apply the AI knowledge to solve problem on search algorithm.

· Develop knowledge base sentences using propositional logic and first order logic.

· Apply first order logic to solve knowledge engineering process.

Course Contents

Unit – 1

Introduction to AI: history, Intelligent systems, foundation and sub area of AI , applications, current trend and development of AI. Problem solving: state space search and control strategies.

Unit – 2

Problem reduction and Game playing : Problem reduction, game playing, Bounded look-ahead strategy, alpha-beta pruning, Two player perfect information games.

Unit – 3

Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic, Logic programming.

Unit – 4

Advanced problem solving paradigm: Planning: types of planning sytem, block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis, Non linear planning strategies, learning plans.

Unit – 5

Knowledge Representation, Expert system

Approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, Knowledge representation using Frames.

Expert system: introduction phases, architecture ES verses Traditional system

Course Map (CO-PO-PSO Map)

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	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

3. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	00
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

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5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Books Recommended:

10. Course Organization

Course Code	DSC213A		
Course Title	Artificial Intelligence		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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SEMESTER 5

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Course Specifications: Machine Learning

Course Title	Machine Learning
Course Code	DSC301A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This course covers a comprehensive journey through the world of Machine Learning. In the first unit, students delve into the foundations of ML, understanding its connection to Data Science, exploring its historical development, types, applications, and the challenges it poses. They gain proficiency in essential tools and data preprocessing techniques. Moving on to the second unit, the focus shifts to supervised learning, encompassing Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machines, k-nearest neighbors, and Ensemble methods. The third unit explores unsupervised learning with an emphasis on clustering algorithms and dimensionality reduction. In unit four, students delve into probabilistic and stochastic models, covering probability basics, Bayes' Theorem, Naïve Bayes, and Bayesian networks. Finally, the fifth unit guides students in fine-tuning their models, emphasizing model selection, hyperparameter training, and practical hands-on experience with tools like NumPy, Pandas, Matplotlib, Seaborn, and Scikit-learn. Throughout the course, students develop a strong foundation in Machine Learning, equipping them with the skills to tackle real-world problems in data analysis and prediction.

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations

Approved by 26th ACM JULY 2022

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Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Understand machine learning concepts and range of problems that can be handled by machine learning, data-preprocessing

CO2. Understanding the theoretical concepts of Regressor and classifier along with hands-on activities using state-of-art algorithms from sklearn , evaluation of model performance

CO3. Discussion about broad range of algorithms under Supervised and Unsupervised learning

CO4. Apply the machine learning concepts in real life problems.

Course Contents

Unit 1: Introduction to ML: Explain the intersection of ML with Data Science, History of machine learning, Introduction, Types of machine learning, Applications of Machine Learning, Perspectives and issues in machine learning, Tools in machine learning, basic types of data in machine learning, Data-preprocessing: Dealing with missing data, Feature scaling, Dealing categorical variables, Model evaluation: Confusion Matrix, Precision, Recall, F1-score, Bias-Variance, Overfitting and Underfitting, ROC, AUC.

Unit 2: Supervised Learning: Linear Regression: Introduction to linear regression, mathematical intuition of linear regression, Cost function, Gradient Descent, Stochastics, Batch and Mini-batch Gradient Descent, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic Regression: Introduction to Logistic Regression and Logistic Classification, Activation and cost function, understanding of different ML algorithms used for solving regression and classification problems, Regularization, ridged(L2) and Lasso(L1) Regularizes

Basic decision tree learning (ID3) algorithm, Entropy, Gini impurity, Information Gain, Math's intuition of decision Tree, pre and post pruning, Hypothesis space search in decision tree learning algorithm, Random Forest, Support Vector Machine algorithm and the math intuition for support vectors, k-nearest neighbor, Ensemble method: Bagging and Boosting, AdaBoost, XGBoost algorithms.

Unit 3: Unsupervised Learning: Intuition of clustering, type of data in clustering analysis, k-means, density-based clustering method (DBSCAN), Performance analysis of clustering algorithms. Dimensionality reduction while retaining information, Principal Component Analysis, Visualization of high-dimensional data, Applications in image recognition, finance, Anomaly Detection.

Unit 4: Probabilistic and Stochastic Models: Basics of probability, Overview of probabilistic models in machine learning, Bayes' Theorem: Concept and significance, Maximum Likelihood Estimation (MLE) in Bayesian Learning, Naïve Bayes Classifier: Understanding conditional

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3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	20
4. Brainstorming Sessions	00	
5. Group Discussions	10	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				

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independence assumption, Naïve Bayes algorithm, Applications of Naïve Bayes in text classification and spam filtering, Basics of Bayesian networks, Representing and reasoning with Bayesian networks(optional)

Unit 5: Fine-Tuning your model: Model Selection and Hyperparameter Training, Cross Validation, Grid Search, Randomized Seach, Pipelines, Data Leakage

Hands On: NumPy, Pandas, Matplotlib, Seaborn, Sklearn packages/modules for preprocessing, Regression and Classification models, Model selection, model accuracy, Normalization, Standardization, model evaluation etc.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3					2			1	2	3	1
CO-2		3				2		1		2	3	1
CO-3	3					2		1		2	3	1
CO-4	3		1					2		2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	05	10
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	0	
Numeracy		
1. Solving Numerical Problems	35	35
Practical Work		
1. Course Laboratory	10	
2. Computer Laboratory	00	10

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CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

1. "Introduction to Machine Learning" by Alpaydin, Introduction to Machine Learning
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurelien Geron
3. "The Hundred-Page Machine Learning Book" by Burkov
4. "Machine Learning Yearning" by Ng , https://info.deeplearning.ai/machine-learning-yearning-book

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Course Code	DSC301A	
Course Title	Machine Learning	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Course Specifications: Big data

Course Title	Big Data
Course Code	DSC302A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This comprehensive Big Data course encompasses five key modules. In Module 1, students delve into the essentials of Big Data, understanding the 4 V's, data storage, communication types, analytical architectures, and the significance of Big Data. Module 2 is dedicated to the Hadoop framework, covering its history, design principles, HDFS, and interactions with the broader ecosystem. Module 3 introduces NoSQL databases and their role in managing Big Data, exemplified through a real-world case study. In Module 4, students dive into MapReduce programming, mastering I/O formats, map functions, sorting, reduce, and various advanced concepts like joins. The course culminates in Module 5, where students explore the Spark framework, from GPU computing and CUDA programming to PySpark, Data Frames, machine learning, and real-time data processing, equipping them with a robust foundation in Big Data technologies and techniques.

Course Size and Credits:

Number of Credits	05

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Credit Structure (Lecture: Tutorial: Practical)	4:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1: Understand the building blocks of Big Data.
CO2: Represent the analytical aspects of Big Data.
CO3: Data model in big data analytics
CO4: Understand and know about map reduce programming, Demonstrate spark programming

Course Contents

module 1: Introduction to big data, Data storage and analysis,4 V's in big data, communication types in big data, typical analytical architecture, challenges and need of big data.

Module 2: Hadoop framework, Introducing Hadoop, Why Hadoop why not RDBMS, RDBMS versus Hadoop, History of Hadoop, Hadoop Overview, Design principles of Hadoop, Hadoop Distributed File System (HDFS), commands/Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN, Interacting with Hadoop Ecosystem, Comparison with other systems. Hadoop components hadoop1 Vs hadoop2

Module 3: NoSQL data module, Introduction to NoSQL, Big drive, data architecture pattern, NoSQL to manage big data, Case study using NoSQL.

Module 4: Maps reduce programming, I/o formats map functions searching, Sorting, Reduce, combine mapper, partition, secondary sorting, pipelining map reduce, comparison, map reduce jobs, Map side join, reduce side join.

Module 5 : Spark framework, Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features [C knowledge required], Introduction to PySpark, PySpark DataFrames, Spark SQL, Data Sources and Data Formats, PySpark Transformations and Actions, PySpark MLlib - Machine

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Learning with PySpark, PySpark Streaming and Recap, Introduction to PySpark Streaming.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1		3	2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		10
1. Course Laboratory	05	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	05	

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4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	10	
2. Guest Lecture	05	
3. Industry / Field Visit	00	20
4. Brainstorming Sessions	05	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

1. Radha Shankarmani, M Vijayalakshmi, Big Data Analytics, Wiley publications,first Edition 2016.
2. Seema Acharya, Subhashini Chellappan, Big Data and Analytics1, Wiley Publication, first edition. Reprint in 2016.
3. Vignesh Prajapati, Data analytics with R and Hadoop1, Copyright © 2013, Packt Publishing.

Course Code	DSC304A

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Course Title	Big Data		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Introduction to Econometrics

Course Title	Introduction to Econometrics
Course Code	DSC304A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This "Introduction to Econometrics" course provides a comprehensive foundation in the field, equipping students with essential knowledge and skills. The course starts by elucidating the fundamental principles, methodologies, and types of econometrics, emphasizing the nature of regression analysis and the Simple Linear Regression Model. It then delves into the Classical Normal Linear Regression Model and explores the significance of assumptions and properties of estimators. Students' progress to understand multiple regression analysis and concepts like the Multiple Coefficient of Determination and Multiple Coefficient of Correlation. The course addresses practical challenges in econometrics, including multicollinearity and heteroscedasticity, offering insights into detection and mitigation techniques. Lastly, students master the handling of autocorrelation and its impact on regression analysis. This course empowers learners to apply econometric methods effectively in real-world scenarios.

Course Size and Credits:

Number of Credits	05

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Credit Structure (Lecture: Tutorial: Practical)	4:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Understand the Fundamentals of Econometrics.
CO2: Master the Classical Linear Regression Model and its Assumptions.
CO3: Analyse and Address Issues in Regression Analysis.
CO4: Grasp the Concept of Autocorrelation and its Impact on Regression.

Course Contents

Unit –I: Introduction to econometrics; Nature, scope, objectives and methodology of econometrics, Types of econometrics, Nature of the regression analysis, Basic assumptions, Simple Linear Regression Model: Two Variable Case, Estimation of model by method of ordinary least squares, properties of estimators, goodness of fit, Gauss-Markov theorem.

Unit-II: Classical Normal Linear Regression Model, Normality Assumption for Disturbances, Properties of ordinary least squares, Estimators under the Normality Assumption, Method of Maximum Likelihood, Multiple regression analysis: Three variable case, ordinary least squares and Maximum Likelihood Estimation of the Partial Regression Coefficients, Multiple Coefficient of Determination, Multiple Coefficient of Correlation.

Unit-III: Nature of Dummy Variables and Multicollinearity, Estimation in the Presence of Perfect Multicollinearity, Estimation in the Presence of "High" but "Imperfect" Multicollinearity, Detection of Multicollinearity, Heteroscedasticity: OLS Estimation in the Presence of Heteroscedasticity, Method of Generalized Least Squares, Detection of Heteroscedasticity.

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Unit-IV: Nature of the Autocorrelation: OLS Estimation in the Presence of Autocorrelation, BLUE Estimator in the Presence of Autocorrelation, Detecting Autocorrelation, Graphical Method, Runs Test.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	2	3						1		3	1	2
CO-2	3				2			1		3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

1. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		10
1. Course Laboratory	00	
2. Computer Laboratory	05	
3. Engineering Workshop / Course/Workshop / Kitchen	05	
4. Clinical Laboratory	00	
5. Hospital	00	

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6. Model Studio	00	
Others		
1. Case Study Presentation	05	20
2. Guest Lecture	05	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	05	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		75

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC_1, SC_2 or SC_3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC_1, SC_2 or SC_3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

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Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books

Suggested Reading:

1. Basic Econometrics Gujarati D.N. McGraw Hill. 2003
2. Essentials of Econometrics Gujarati D.N. and Porter D.C. McGraw Hill, 4th edition 2009
3. Introduction to Econometrics Koop G. John Wiley 2007
4. Introduction to Econometrics Maddala GS. MacMillan 1992
5. Econometrics Maddala GS. McGraw Hill 1997
6. Introduction to Econometrics Maddala G.S. and Lahiri, K. John Wiley and Sons, 4thedition

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Course Code	DSC304A		
Course Title	Introduction to Econometrics		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Advanced Time Series and forecasting

Course Title	Advanced Time Series and Forecasting
Course Code	DSC303A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This "Time Series and Forecasting" course covers a comprehensive spectrum of time series analysis and Bayesian learning. Students start by understanding univariate and seasonal time series models, including AR, MA, ARMA, ARIMA, and SARIMA, as well as their selection and forecasting. Advanced topics encompass multivariate analysis, cointegration, Granger causality, and time series clustering. The course then delves into Bayesian learning principles, exploring Bayes' theorem, model selection, parameter estimation, and its application in regression and classification problems. By the end of the course, students will have the knowledge and skills to analyze time series data and employ Bayesian approaches in various data analysis tasks.

Course Size and Credits:

Number of Credits	05

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Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Understand the fundamental concepts of time series analysis, including autoregressive (AR) models, moving average (MA) models, ARMA models, ARIMA models, and seasonal time series models.
CO2: Develop the skills to select appropriate time series models and estimate their parameters using diagnostic checking and model evaluation techniques.
CO3: Gain proficiency in forecasting future values and making predictions using time series models, specifically SARIMA models.
CO4: Explore advanced topics in time series analysis, such as multivariate time series analysis, vector autoregression (VAR) models, cointegration, error correction models, Granger causality tests, time series clustering, and classification.
CO5: Understand the Bayesian learning framework, including Bayes theorem, hypothesis testing, maximum likelihood estimation, and Bayesian model selection and comparison.

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Course Contents

Module 1: Brief introduction on time series, Autoregressive (AR) models, Moving average (MA) models, Autoregressive moving average (ARMA) models, Autoregressive integrated moving average (ARIMA) models, Model selection and parameter estimation, Diagnostic checking and model evaluation

Module 2: Seasonal decomposition of time series, Seasonal autoregressive integrated moving average (SARIMA) models, Seasonal and non-seasonal differencing, Seasonal ARIMA (SARIMA) model selection, Forecasting with SARIMA models

Module 3: Multivariate time series analysis, Vector autoregression (VAR) models, Co-integration and error correction models, Granger causality tests, Time series clustering and classification, ARCH and GARCH process, Introduction to index numbers.

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Module 4: Bayes theorem, Maximum likelihood and least-squared error hypotheses, differences between Bayesian and frequentist approaches, Advantages and challenges of Bayesian learning, Bayesian estimation: Maximum a posteriori (MAP) estimation, Bayesian parameter estimation using conjugate priors, Bayesian formulation of linear regression, Bayesian formulation of classification problems, Naive Bayes classifier, Bayesian logistic regression.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

2. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		20
1. Course Laboratory	10	
2. Computer Laboratory	10	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	10
4. Brainstorming Sessions	05	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

- "Time Series Analysis: With Applications in R" by Jonathan D. Cryer and Kung-Sik Chan
- "Analysis of Time Series Structure: SSA and Related Techniques" by Wolfgang Karl Härdle and Holger Dette
- "An Introduction to Time Series Analysis and Forecasting" by Douglas C. Montgomery and Cheryl L. Jennings
- "Time Series Econometrics" by Walter Enders
- https://www.bayesrulesbook.com/

Course Code	DSC303A
Course Title	Advanced Time Series and forecasting

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Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

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SEMESTER 6

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Course Specifications: Deep Learning

Course Title	Deep Learning
Course Code	DSC303A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This course covers a comprehensive overview of artificial neural networks (ANNs), with a focus on various types of networks and their applications. In Unit I, students will learn about basic ANN models, including Supervised Learning Networks and important concepts like Perceptron and Back-propagation. Unit II delves into Unsupervised Learning Networks, Special Networks, and different network architectures. Unit III introduces deep learning, its historical trends, and applications in natural language processing and time series prediction.

In Unit IV, students will explore techniques for regularization in deep learning, including parameter penalties, dataset augmentation, and ensemble methods. Unit V focuses on Convolutional Neural Networks (CNNs), transfer learning, advanced CNN architectures, and their applications in object detection and image segmentation. Additionally, the course introduces Generative Adversarial Networks (GANs) and their use in image synthesis and image-to-image translation. Students will gain a solid foundation in ANN concepts and their practical applications.

Course Size and Credits:

Number of Credits	04

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Credit Structure (Lecture: Tutorial: Practical)	2:1:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

On completion of this course, the student will be able to:

CO-1: To introduce the foundations of Artificial Neural Networks

CO-2: To acquire the knowledge on Deep Learning Concepts

CO-3: To learn various types of Artificial Neural Network

CO-4: To gain knowledge to apply optimization strategies

Course Contents

UNIT-I

Artificial Neural Networks Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

UNIT-II

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation

Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.

UNIT - III

Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feed - forward networks, Gradient-Based learning, Gradient descent and SGD Adaptive learning rate methods

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(Adam, RMSprop) , Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms, Introduction to LSTM and GRU, Applications in natural language processing (Sentiment analysis using LSTMs) and time series prediction

UNIT - IV

Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier

UNIT – V

Introduction to CNN, Transfer learning (Alexnet, Resnet, Vnet), Advanced CNN architectures (e.g., Inception, DenseNet), Object detection with CNNs (e.g., YOLO, SSD), Image segmentation using CNNs. Understanding Generative Adversarial Networks (GANs) and their components, Training GANs for image synthesis, Applications of GANs in image-to-image translation

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	2	2	3	1	2	3	3	2	3	2	3	3
CO-2	1	1	2	1	1	2	2	1	2	1	2	2
CO-3	2	1	3	1	2	3	2	2	3	1	3	3
CO-4	1	2	2	2	2	1	1	1	2	1	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

1. *Course Teaching and Learning Methods*

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

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Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				

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CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs
The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books
Suggested Reading:
1. Deep Learning: An MIT Press Book By Ian Goodfellow and Yoshua Bengio and Aaron Courville

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2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall.

Course Code	DSC311A		
Course Title	Deep Learning		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Risk Management

Course Title	Risk Management
Course Code	DSC313A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

This course, "Introduction to Risk Management," provides a comprehensive overview of risk-related topics. It begins by defining risk, distinguishing it from uncertainty, and categorizing risks based on their dynamic nature. Students learn to identify risk sources, quantify risks using various methods, and assess their impact on stakeholders. The course emphasizes the critical roles of Risk Managers and Risk Committees.

Risk management concepts and objectives are explored, highlighting the significance and introducing key techniques. Students gain insights into aligning risk management strategies with business goals, integrating internal controls, understanding risk culture, and practicing integrated risk reporting. IT risk management and disaster recovery are also covered.

Additionally, risk modeling techniques, credit risk assessment and mitigation, governance-related risks, and enterprise and operational risk management are discussed. This course equips students with a holistic understanding of risk management, preparing them to navigate the complex landscape of risks across various domains.

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Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

On completion of this course, the student will be able to:

1. Understand Risk Concepts: Students will grasp the fundamental concepts of risk, distinguish between risk and uncertainty, and classify various types of risks prevalent in business environments.
2. Evaluate Risk Sources and Impact: Students will learn to identify and assess sources of risk, quantify risk using appropriate methodologies, and analyze its impact on stakeholders and organizational performance.
3. Master Risk Management Techniques: Through exploration of risk management techniques, students will develop skills to mitigate and control risks effectively, align risk management with business strategies, and foster a proactive risk culture.
4. Analyze Risk Models: Students will gain insights into risk modeling, including VAR, stress testing, and scenario analysis, enabling them to make informed decisions based on risk assessment.
5. Comprehend Corporate Governance Risks: Students will examine the relationship between risk and corporate governance, evaluate governance-related risks, and understand the role of board-level considerations in effective risk management.

Course Contents

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1. INTRODUCTION TO RISK

The Concept of Risk, Risk and Uncertainty: Distinction, Classification of Risks, Dynamic Nature of Risks, Types of Risk

2. SOURCE AND EVALUATION OF RISKS

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Identification and Sources of Risk, Quantification of Risk and various methodologies, Impact of Business Risk, Identify and assess the impact upon the stakeholder involved in Business Risk, Role of Risk Manager and Risk Committee in identifying Risk

3. RISK MANAGEMENT

Concept of Risk Management, Objective and Process of Risk Management, Importance of Risk Management, Risk Management techniques

4. EVALUATION OF RISK MANAGEMENT STRATEGIES

Risk Management Strategy alignment with Business Strategy, Internal Control environment and linkages with Risk Management, Risk Culture and attitudes to risk management, Integrated Risk Reporting and Stakeholder responsibilities, IT Risk Management – Disaster Recovery

5. RISK MODEL

VAR, Stress Testing, Scenario Analysis, Country and Sovereign Risk Models and Management

6. CREDIT RISK MEASUREMENT AND MANAGEMENT

Understanding the component of credit risk, Evaluating credit risk, Mitigating Credit risk, Qualitative and Quantitative techniques to manage risk, Credit scoring models

7. RISK ASSOCIATED WITH CORPORATE GOVERNANCE

Evaluation of Risk Associated with Governance, Description and evaluation of framework for Board level consideration of risk,OECD Guidelines for Corporate Governance

8. ENTERPRISE RISK MANAGEMENT

Definition Scope and Techniques

9. OPERATIONAL RISK MANAGEMENT

Definition, Scope and Techniques

Course Map (CO-PO-PSO Map)

Course outcome	**Programme outcomes**									**Programme specifications**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3	2	2	1	3	3	3	2	1	3	3	2
CO-2	3	3	2	1	3	2	3	2	1	3	3	2
CO-3	2	2	2	1	3	2	2	2	1	2	3	2
CO-4	2	2	2	1	3	2	2	2	1	2	2	1
CO-5	3	2	2	1	3	3	3	2	1	3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

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1. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

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The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	100 Marks
Maximum Marks ▶	50	25	25	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs
The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment

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7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

1.Risk Analysis: A Quantitative Guide 2nd Edition - by David Vose

2."Strategic Risk Management Practice: How to Deal Effectively with Major Corporate Exposures" by Torben Juul Andersen.

3."Principles of Risk Management and Insurance" by George E. Rejda.

4."The Essentials of Risk Management" by Michel Crouhy, Dan Galai, and Robert Mark.

Course Code	DSC313A	
Course Title	Risk Management	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

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Course Specifications: Dissertation

Course Title	**Dissertation**
Course Code	21BSDSI311A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

Students will undertake an independent research study or project focusing on a question or topic directly related to Data Science and Analytics. Building upon the research proposal developed during the Research Dissertation phase, students will carry out the research, gather data, analyze it comprehensively, and ultimately submit the final dissertation.

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2. *Course Size and Credits:*

Number of Credits	06
Credit Structure (Lecture: Tutorial: Practical)	
Total Hours of Interaction	
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. *Course Outcomes (COs)*

After the successful completion of this course,
CO-1 Methodology Design and Justification: Students will be proficient in designing and providing rationale for research methodologies used in data collection.

CO-2 Research Ethics and Approval Process: Students will demonstrate a deep understanding of research ethics and the process of obtaining ethical approval.

CO-3 Effective Data Collection and Data processing: Students will be able to employ suitable research methodologies to collect data in a well-informed manner and clean them to put them to good use.

CO-4 Critical Data Analysis and modelling: Students will possess the skills to critically analyze the collected data and draw conclusions that are sound and substantiated.

CO-5 Academic Presentation: Students will be capable of presenting their research findings and conclusions in a manner consistent with academic standards and expectations.

4. *Course Contents*

A dissertation is the final and most significant output of your B.Sc (Hons) Data Sciences and Analytics Program. Its primary purpose is to convey the essence and results of your research endeavor. Should you successfully complete the course, you have the option to have it formally bound and presented as a physical document.

The structure and content of your dissertation should include the following key elements:

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Research Background: Provide a comprehensive overview of the context and existing knowledge in the field that your research addresses. This section should establish the foundation upon which your research is built.

Methodology: Detail the methods and approaches you used to conduct your research. Explain why you chose these methods and how you implemented them to investigate your research questions or objectives.

Experiments: Describe the experiments, studies, or data collection processes you conducted as part of your research. This section should include information on the setup, data collection, and any relevant details regarding your experiments.

Results: Present the outcomes of your research, both in quantitative and qualitative terms. Use tables, figures, and other visual aids as necessary to illustrate your findings.

Analysis: Discuss the interpretation and analysis of the results. Explain the significance of your findings and how they relate to your research questions or objectives. Consider any unexpected results and their implications.

Conclusions: Summarize the key takeaways from your research. Explain how your research contributes to the field and what implications it has. Address any limitations and suggest areas for future research.

References: Ensure your dissertation is well-referenced. Cite all sources, including academic papers, books, and other materials you used during your research.

Structure and Writing: Your dissertation should be meticulously organized and well-written. Pay attention to proper grammar, punctuation, and clarity of expression.

Length: The recommended length for your dissertation is between 10,000 and 15,000 words. Be concise and precise in your writing, while ensuring that you cover all necessary information.

In summary, your dissertation is the culmination of your research efforts in INFO/SENG490, and it should be a high-quality, comprehensive document that showcases your research skills and findings. It serves as a valuable resource for both your academic community and potentially beyond, depending on the scope and significance of your research.

5. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	2	2	3	2	2	2	2	2	2	2	3	1

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CO-2	2	2	3	2	2	2	2	2	2	2	3	1
CO-3	2	2	3	2	2	2	2	2	2	3	3	2
CO-4	3	2	2	3	3	2	2	2	2	2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. *Course Teaching and Learning Methods*

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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SEMESTER 7

Course Specifications: Cloud Computing

Course Title	Cloud Computing
Course Code	DSC401A
Course Type	Core Theory
Departmen t	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

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Virtualization – Virtualization and Cloud Computing

UNIT III: Data Storage and Cloud Computing: Data Storage–Cloud Storage–Cloud Storage

from LANs to WANs –Cloud Computing Services: Cloud Services –Cloud Computing

at Work

UNIT IV: Cloud Computing and Security: Risks in Cloud Computing–Data Security in Cloud–

Cloud Security Services –Cloud Computing Tools: Tools and Technologies for Cloud –

Cloud Mashaps–Apache Hadoop –Cloud Tools

UNIT V: Cloud Applications: Moving Applications to the Cloud –Microsoft Cloud Services –

Google Cloud Applications –Amazon Cloud Services –Cloud Applications

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		
1. Demonstration using Videos	00	

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This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	2:1:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Understand the Fundamentals of Cloud Computing

CO2: Explore Cloud Computing Architecture

CO3: Learn about Data Storage in the Cloud

CO4: Address Cloud Computing Security Concerns

CO5: Explore Cloud Application Development and Deployment

Course Contents

UNIT I: Cloud Computing Foundation: Introduction to Cloud Computing–Move to Cloud Computing–Types of Cloud –Working of Cloud Computing

UNIT II: Cloud Computing Architecture: Cloud Computing Technology–Cloud Architecture–

Cloud Modeling and Design -Virtualization: Foundation –Grid, Cloud and

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2. Demonstration using Physical Models / Systems	00	00
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	35	35
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	00
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation

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	Component 1: CE (50% Weightage)			Component 2: SEE (50% Weightage)
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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Reference Books:

1: A.Srinivasan and J.Suresh, "Cloud Computing –A Practical Approach for Learning and

Implementation", Pearson India Publications2014.

2: RajkumarBuyya, James Broberg, Andrzej, "Cloud Computing: Principles and

Paradigms",Wiley India Publications2011.

3: ArshdeepBahga and Vijay Madisetti, "Cloud Computing –A Hands on Approach",

Universities Press (India) Pvt Ltd. 2014.

Course Code	DSC401A		
Course Title	Cloud Computing		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Advanced ML

Course Title	Advanced ML
Course Code	DSC402A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

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Course Summary

This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

CO1: Gather data from websites and APIs, and handle various data formats like HTML, JSON, and XML.

CO2: Comprehend the importance and applications of recommender systems and conduct customer analytics, including RFM analysis and customer lifetime value modelling.

CO3: Utilize deep learning algorithms to address computer vision tasks.

CO4: Evaluate machine learning models using appropriate metrics for imbalanced datasets.

CO5: Explore fraud detection and anomaly detection techniques using statistical and machine learning methods.

Course Contents

Unit 1: Web Scraping and Data Collection, Introduction to web scraping and its importance in data collection, Web scraping tools and libraries (Beautiful Soup, Scrapy, Spacy), Extracting data from websites and APIs, Handling data formats (HTML, JSON, XML), Ethical considerations and legal aspects of web scraping.

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Unit 2: Text Mining and Sentiment Analysis, Advanced text preprocessing techniques, Topic modeling and text clustering, Sentiment analysis using machine learning and deep learning, Extracting insights from text data, social media analysis and opinion mining.

Unit 3: Introduction to Recommender Systems, Overview of recommender systems and their importance, Collaborative filtering techniques, Content-based filtering methods, Hybrid approaches in recommender systems, Evaluation metrics for recommender systems.

Unit 4: Image Processing and Computer Vision, Fundamentals of image processing and computer vision, Image enhancement and filtering techniques, Object detection and recognition algorithms, Image segmentation and feature extraction, Deep learning for computer vision applications.

Unit 5: Machine Learning with Imbalanced Data, Understanding imbalanced datasets and their challenges, Techniques for handling class imbalance (oversampling, under sampling), Cost-sensitive learning and ensemble methods, Evaluation metrics for imbalanced datasets, Case studies and applications of machine learning with imbalanced data.

Unit 6: Fraud Detection and Anomaly Detection Techniques, Overview of fraud detection and anomaly detection, Statistical methods for fraud detection, Machine learning-based fraud detection techniques, Unsupervised anomaly detection algorithms.

Unit 7: Customer Analytics and Segmentation, Introduction to customer analytics and segmentation, RFM analysis and customer lifetime value modeling, Clustering algorithms for customer segmentation, Market basket analysis and association rules mining, Personalization and targeted marketing strategies, Evaluation and interpretation of fraud and anomaly detection models.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2

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CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

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Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment -2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	**Curriculum and Capabilities Skills**	**How imparted during the course**
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination

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6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books:

1. Machine Learning Yearning by Andrew Ng.

2. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar.

3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.

Course Code	DSC403A	
Course Title	Advanced ML	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

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Course Specifications: Social network Analysis

Course Title	Social Network Analysis
Course Code	DSC403A
Course Type	Core Theory
Departmen t	Data Sciences and Analytics
Faculty	School of Social Sciences

Course Summary

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This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

Course objective

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

Course Contents

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis , Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

Unit II: Modelling, aggregating and knowledge representation

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data:

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State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Unit III : Extraction and mining communities in web social networks

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT IV : Predicting human behaviour and privacy issues

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

Unit V: Visualization and applications of social networks

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Unit VI: Human Factor Psychology

Introduction to Human Factor Psychology - Definition and scope of Human Factor Psychology - Historical overview and key contributors in the field - Importance of human factors in various domains (aviation, healthcare, technology, etc.) - Human Information Processing - Sensation and perception in human cognition - Attention and its limitations - Memory processes and implications for design - Cognitive Workload and Multitasking - Understanding cognitive workload and its impact on performance - Challenges of multitasking and its consequences on task execution - Strategies to mitigate cognitive overload and multitasking issues - Human-Computer Interaction (HCI) - Basics of HCI and its relationship with Human Factor Psychology - User-centered design principles - Usability testing and evaluation methods.

Unit VII: Applications of Human factor Psychology:

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Human Factors in Automation - Benefits and challenges of automation in various industries - Human-automation interaction and issues with trust and complacency - Design considerations for effective human-automation collaboration - Designing for User Experience - Elements of user experience design - Emotional aspects and affective computing - Integrating emotional design in product development - Human Factors in Transportation - Human performance in driving and aviation contexts - Designing vehicle interfaces and cockpit controls - Addressing human errors in transportation systems - Human Factors in Healthcare - Understanding patient safety and medical errors - Designing healthcare systems and medical devices for usability - Impact of workload and stress on healthcare professionals

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									**Programme Specific Outcomes (PSOs)**		
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs
The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books

Suggested Reading:
TEXT BOOKS:

1.Peter Mika, –Social Networks and the Semantic Webl, First Edition, Springer 2007.

2.Borko Furht, –Handbook of Social Network Technologies and Applicationsl, 1st Edition, Springer, 2010.

REFERENCES

1.Guandong Xu ,Yanchun Zhang and Lin Li, –Web Mining and Social Networking – Techniques and applicationsl, First Edition, Springer, 2011.

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2.Dion Goh and Schubert Foo, –Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectivelyl, IGI Global Snippet, 2008.

10. Course organisation

Course Code	DSC404A		
Course Title	Social network Analysis		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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Course Specifications: Application to Economics

Course Title	Application to Economics
Course Code	DSC404A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Registrar
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Course Summary

This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical

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organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:1:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Course Outcomes (COs)

Carry out reasonably good predictions and evaluate their performance;

1. Evaluate the predictive performance of all kinds of models;
2. Build machine learning models with some of most widely used methods such as random forestand boosting.
3. Discuss and evaluate results of predictive analysis.
4. Present the results of predictive analytics and write short reports;
5. Evaluate the merits of presentations and reports that carry out predictive analytics.

Course Contents

Unit-1 Review

Tech review: API, git, markdown.

Stat review: Building regressions, OLS, LPM and logit. Uncertainty and generalization from data. prediction error, loss function, RMSE, prediction with regression, overfitting, external validity, cross-validation, BIC, RMSE,

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Unit-2 Model Building for Prediction

Sample design, label engineering and functional form selection, building and selecting models, evaluation, Variable selection with LASSO, model diagnostics, Big Data

Case study: Used cars , Airbnb

Cross-validation, model evaluation, LASSO

Unit-3 Introduction to Machine learning and regression trees

Algorithms, CART, stopping rules, pruning, search algorithms, variable importance

Case study: Used cars

Machine learning with CART. PDP and Variable importance.

Unit-4 Random Forest Ensemble methods

Boosting, decorrelating trees, regression vs random forest, diagnostics, GBM

Case study: Airbnb

Machine learning with Random forest, GBM, XGBoost

Unit-5 Classification

Predicting probabilities, loss functions, finding the classification threshold, classification, evaluation, Random Forest, class imbalance, process and diagnostics

Case study: Firm default

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)	**Programme Specific Outcomes (PSOs)**

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	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		75
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

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Term Tests, Laboratory Examination/Written Examination, Presentations	00
Total Duration in Hours	**75**

Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			**Component 2: SEE (50% Weightage)**
Subcomponent ▶	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▶	**Midterm exam**	**Assignment -1**	**Assignment-2**	**100 Marks**
Maximum Marks ▶	**50**	**25**	**25**	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

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4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Reference Books

Suggested Reading:
Textbook:

1. Békés, Gábor and Gábor Kézdi, "Data Analysis for Business, Economics, and Policy". Cambridge University Press, 2021 (Chapters 10, 11, 13-17)

Optional reading

1. James, Witten, Hastie, Tibshirani (2017) - An Introduction to Statistical Learning: with

Applications in R , Springer (selected chapters) – available:

2. http://faculty.marshall.usc.edu/gareth-james/ISL/ISLR%20Seventh%20Printing.pdf

Course Code	DSC405A		
Course Title	Application to Economics		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

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SEMESTER 8

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Course specification: Internship/Capstone Project

Course Title	**Internship**
Course Code	21BSDSC411A
Course Type	Core course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. *Course Summary*

This internship opportunity is designed to empower students pursuing a Bachelor of Data Science and Analytics to develop and put into practice essential career readiness skills. Through this program, students will engage in work placements within relevant workplace settings, including hospitals, industries, businesses, not-for-profit organizations, government agencies, scientific institutions, or community-based entities. These internships will be granted to students based on their merits, following a competitive application process.

Before commencing the internship, a specific project or set of activities will be defined and agreed upon collaboratively by the host organization, the student, and the university. The course structure will encompass the integration of on-site placement attendance, along with university-based preparatory work and assessments. This combination will typically amount to a commitment of a few days per week, ensuring that students gain both practical experience and academic support throughout their internship journey.

2. *Course Size and Credits:*

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Number of Credits	06
Credit Structure (Lecture: Tutorial: Practical)	
Total Hours of Interaction	
Number of Weeks in a Semester	15
Department Responsible	Psychology
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. *Course Outcomes (COs)*

After the successful completion of this course:

CO-1: Students will be proficient in identifying and articulating the skills and competencies gained through their academic curriculum, co-curricular engagements, and extracurricular pursuits that align effectively with the demands of the industry.

CO-2: They will develop an understanding of how their educational background complements industry requirements.

CO-3: Students will demonstrate their capacity to apply their knowledge of Data Science and Analytics, relevant theories, and practical skills in a workplace environment.

CO-4: Students will engage in reflective learning practices to assess and derive insights from their internship experiences.

1. *Course Contents*

Scheduled Learning Activities and Topics:
The specific topics covered during the course may vary depending on each student's unique placement.

Methods for Assessing Course Learning Objectives:
The assessment of course learning objectives will be conducted through a combination of methods, including an evaluation of the student's performance by their site supervisor. Additionally, it will involve the assessment of assignments, such as maintaining a weekly log, reflecting on the application of major theories, and submitting a final paper. These assignments will be reviewed and graded by the designated course instructor.

Students are required to select a client organization and a qualified faculty advisor who consents to oversee their Internship. Following this, students must outline a Scope of Work that enables them to employ principles derived from the curriculum in order to execute a project that is of mutual interest to both the student and the client. Within this Scope of Work, it is essential to

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incorporate relevant readings from the curriculum that contribute to the successful completion of the project.

4. *Course Map (CO-PO-PSO Map)*

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO-8	PO-9	PSO -1	PSO -2	PSO-3
CO-1	1	2	3	1		1				3	1	2
CO-2	1	2	3	1		1				3	1	2
CO-3	1	2	3	1		1				3	1	2
CO-4	1	2	3	1		1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. *Course Teaching and Learning Methods*

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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Approved by 26th ACM JULY 2022

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