RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Specifications Of M.Sc. Data Science and Analytics

2025 onwards

School of Social Sciences
Department of Data Sciences and Analytics

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
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	School of Social Sciences
Department	Data Sciences and Analytics
Programme Code	170
Programme Name	M.Sc. Data Science and Analytics
Dean of the Faculty	Shri Gurucharan Gollerkeri
Head of the Department	Dr. Tapasi Ghosh

1. **Title of the Award:** M.Sc. Data Science 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:** 22-March-2024

7. Date of Programme Approval by the 31st Academic Council Meeting of MSRUAS: 22-March-2024
8. Next Review Date: June 2026

9. Programme Approving Regulating Body and Date of Approval: Academic Council of MSRUAS, 22-March-2024

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.

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

14. Rationale for the Programme

M.Sc. Data Science and Analytics is apostgraduate degree programme designed to create motivated, energetic, thinking, and creative post 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, and 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

M.Sc. (Hons.) in Data Science 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 and science fundamentals to solve complex problems in Data Sciences.

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

GA-3. Design and Development of Solutions: Ability to design a 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

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)

M.Sc. (Hons) (Data Science and Analytics) graduates will be able to:

PO1: Apply the knowledge of Data Sciences and Data Analytics to the solution of complex societal problems.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: Create new conceptual, theoretical, methodological innovations that integrate and transcend beyond discipline-specific approaches to address a common problem.

PO6: 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.

PO7: 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.

PO8: Analyze the impact of the scientific solutions in societal and environmental contexts for sustainable development.

PO9: 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.

19.Programme Educational Objectives (PEOs)

The objectives of the M.Sc. Data Science and Analytics programme are to:

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

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 M.Sc. Data Science 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. Demonstrate the understanding of life-long learning and leadership qualities through professional development and strive for the betterment of organization, environment, and society.

21. Programme Structure:

Semester 1							
Sl. No.	Course Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC501A	Advanced Mathematics for Data Science	4	0		4	100
2	DSC502A	Advanced Statistical Methods	3		2	4	100
3	DSC503A	Data Base Management System and Advanced SQL	3		2	4	100
4	DSC511A	Fundamentals in programming	2		4	4	100
5	DSC505A	Applied Econometrics	3		2	4	100
6	DSL501A	Spreadsheet Analytics			4	2	50
Total			15	0	14	22	550
Total number of contact hours per week			**29**				

Semester 2							
Sl. No.	**Course Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S)**	**Total Credits**	**Max. Marks**
1	DSC507A	Data Acquisition and Data Pre-processing	3		2	4	100
2	DSC508A	Advanced Machine Learning	3		2	4	100
3	DSC509A	Optimization Methods and it's Applications	3		2	4	100
4	DSC510A	Research Methodology	3			3	100
5	DSE501A	Introduction to Geoinformatics	2		2	3	100
6	DSE502A	Data Communication and Networking	3				
7	DSP501A	Project			8	4	100
	Total		17		16	22	600
Total number of contact hours per week			**33**				

Semester 3							
Sl. No.	**Code**	**Course Title**	**Theory (h/W/S)**	**Tutorials (h/W/S)**	**Practical (h/W/S) 1 credit =2 hours**	**Total Credits**	**Max. Marks**
1	DSC601A	Big data and Cloud Technologies	3	0	2	4	100
2	DSC602A	Multivariate Techniques For Data Science	4	0	0	4	100
3	DSC603A	Data Story telling	0	0	4	2	100
4	DSC604A	Generative AI	1	0	2	2	100
5	DSE604A	Computer vision	3	0	2	4	100
	DSE601A	Supply Chain Management and Analytics	4	0	0		

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

Director
School of Social Sciences & School of Law
M.S.Ramaiah University of Applied Sciences
Bengaluru – 560054

6	DSE602A	Data Analytics in Healthcare	3	0	2	4	100
	DSE603A	Applied Geoinformatics					
Total			**11/12**	**0**	**10/8**	**16**	**600**
Total number of contact hours per week			**21/20**				

Semester 4							
Sl. No.	Course Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSP601A	Research Project			40	20	100
	Total				40	20	100
Total number of contact hours per week			40				

23. Course Delivery: As per the Timetable

24. 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

25. Assessment and Grading

1. **For the courses having 100% theory - 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 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.

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

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 Examination, 50% Marks
		Conduction of Lab %	Lab Record Submission %	Viva %	Lab test (%)	
1	CO -1					

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

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.

4. Minor Programme: NA

5. Student Support for Learning:

a. Course Notes
b. Reference Books in the Library
c. Magazines and Journals

d. Internet Facility
e. Computing Facility
f. Laboratory Facility
g. Workshop Facility
h. Staff Support
i. Lounges for Discussions
j. Any other support that enhances their learning

6. Quality Control Measures

a. Review of Course Notes
b. Review of Question Papers and Assignment Questions
c. Student Feedback
d. Moderation of Assessed Work
e. Opportunities for students to see their assessed work
f. Review by external examiners and external examiners reports
g. Staff Student Consultative Committee meetings
h. Student exit feedback
i. Subject Assessment Board (SAB)
j. Programme Assessment Board (PAB)

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	Advanced Mathematics for Data Science	3	2	2	2	3	2	1	2	2	3	3	2
1	Advanced Statistical Methods	3	2	2	3	2	2	1	2	2	3	2	2
1	Data Base Management System and Advanced SQL	3	2	2	2	2	2	2	1	3	3	2	2
1	Fundamentals in programming	3	3	2	2	3	2	1	2	2	3	3	3
1	Applied Econometrics	2	3	2	2	3	2	1	1	1	2	3	2
1	Spreadsheet Analytics	3	2	2	2	2	1	1	2	2	3	2	2

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

2	Data Acquisition and Data Pre-processing	3	3	2	2	3	2	1	2	2	3	3	3
2	Advanced Machine Learning	3	3	2	3	3	3	2	2	2	3	3	3
2	Optimization Methods and it's Applications	3	3	2	2	3	3	2	3	2	3	3	3
2	Research Methodology	3	2	2	2	2	2	2	2	2	3	3	2
2	Introduction to Geoinformatics	3	2	2	2	2	2	2	1	3	3	2	2
2	Data Communication and Networking	2	3	3	3	2	3	2	2	3	3	2	3
2	Project	3	2	2	2	2	2	2	2	2	3	3	2
3	Big data andCloud Technologies	3	3	2	3	3	2	1	2	2	3	3	3
3	Multivariate Techniques For Data Science	3	2	2	3	2	2	1	2	2	3	2	2
3	Data Story telling	3	3	2	3	3	3	2	2	2	3	3	3
3	Generative AI	3	3	2	3	3	2	2	3	2	3	3	3
3	Computer vision	3	3	2	2	3	2	1	2	2	3	3	3
3	Supply Chain Management and Analytics	3	3	2	3	3	3	3	3	3	3	3	3
3	Data Analytics in Healthcare	3	2	2	2	2	3	2	3	2	2	2	3
3	Applied Geoinformatics	3	3	2	3	3	2	2	2	2	3	3	3
3	Big data and Cloud Technologies	3	3	2	3	3	2	2	3	2	3	3	3
3	Multivariate Techniques For Data Science	3	2	2	2	2	2	2	2	2	3	3	2
3	Data Story telling	3	3	2	3	3	3	2	3	2	3	3	3
4	Project/Internship	3	3	3	3	3	3	3	3	3	3	3	3

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.

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Course Specifications

M.Sc. Data Science and Analytics

Programme Code: 170

School of Social Sciences

Batch 2025 onwards

Approved by the Academic Council at meeting held on March 2024

SEMESTER 1

Associate Professor and HOD
Depart... Sciences and Analytics
...School of Social Sciences
M S R... University of Applied Sciences
...galuru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

Course Specifications: Foundational Mathematics for Data Science

Course Title	Advanced Mathematics for Data Science	
Course Code	DSC501A	
Course Type	Core - Theory	
Department	Data Sciences and Analytics	
Faculty	School of Social Sciences	

1. Course Summary

This course provides a comprehensive foundation in advanced mathematical concepts essential for data science. Students will explore Linear Algebra by studying vector spaces, eigenvalues, matrix decompositions, and linear transformations. They will analyze Sequences and Series, focusing on convergence criteria, series tests, and series of functions. Finally, students will learn about Topology, understanding topological spaces, continuity, compactness, and advanced concepts like homotopy and fundamental groups. These topics will equip students with a robust mathematical toolkit applicable to various data science challenges.

2. Course Size and Credits:

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
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-1.1.Understand and apply linear algebra concepts relevant to data science, including vector spaces, eigenvalues, and eigenvectors.

CO-2. Understand and analyze real-valued sequences, series and functions, in terms of the limit concept applied to convergence of sequences and infinite series as well as to continuity, differentiability and integrability of functions.

CO-3. Understand the structure of real-valued functions through application of key concepts of continuity, differentiability, and integrability of functions, including theorems like Intermediate Value, Mean Value, and the Fundamental Theorem of Calculus.

CO-4. Understand and apply concepts from topology, including the notions of closeness and continuity as well as of connectedness and compactness underlying the structure of topological spaces to data science.

4. Course Contents

Unit 1: Linear Algebra

Basics of matrices, Definition and examples, Characteristic polynomial, Eigenvalues and Eigenvectors, Vector Space, Subspaces, Row space, Columns Space, Linear combinations, span and basis, Dimension and rank, Linear Transformations, Kernel and image, Matrix representation of linear transformations, Change of basis, Homogeneous and non-homogeneous systems and solutions by Gaussian methods, Diagonalization, LU decomposition.

Unit 2: Analysis-I

Numbers: Basic properties of numbers - natural numbers, integers, rational numbers, and real numbers (rational and irrational) counting, order and measuring. Properties of general arithmetical operations - commutativity, associativity and distributivity; inverse operations. Elementary Set theory, set, empty set, equality, subset, union of sets, intersection of sets, power set, ordered pair of sets, and Cartesian product of sets. Function: domain, codomain, range, maximum and minimum, arithmetical sum, difference and composition; graphs of real-valued functions. Theory of limits: Bounded subsets of real numbers; limit points of a subset of real numbers; upper and lower limits of real-valued sequences; limit of a sequence. Arithmetical properties of limits - sum, difference, product, and ratio of pairs of limits of sequences. Bolzano-Weierstrass Theorem; Least Upper Bound Theorem; Nested Intervals Theorem; Heine-Borel Theorem. Theory of Convergence; Definition of infinite series; convergence and divergence of infinite series; Tests for convergence - Comparison test, Ratio test, Root test, and Cauchy Condensation test.

Unit 3: Analysis-II

Continuity of Functions: Graphical representation of real-valued functions; definition of continuous functions; constant and linear functions; discontinuous functions; transcendental functions - exponential and trigonometric functions. *Properties of continuous functions*; Intermediate Value Theorem, Boundedness, and Attainment of Bounds Theorem; Uniform continuity. Sequence of functions, *Differentiability of functions:* Definition of derivative of a function at a given value, and differentiability over an interval; graphical interpretation of derivative of a function as slope of the tangent to the associated curve; differentiability of constant, linear and quadratic functions. *Properties of differentiable functions*: Differentiability of sum, difference, product, ratio and composition of differentiable functions (Chain Rule); derivatives of standard functions- power function xn, polynomials, exponential, logarithm and trigonometric

functions; Rolle's Theorem, Mean Value Theorem, Taylor's Theorem and Maclaurin's Theorem; Newton-Rhapson algorithm. *Riemann-integrability of* functions: Fundamental Theorem of Calculus; Integration by parts; integrals of power function, exponential, logarithm and trigonometric functions; Simpson's Rule.

Unit 4: Topological Data Analysis

Definition of Topological Spaces,Open, and closed sets, Basis and subbasis, Examples: Euclidean spaces, discrete topology, trivial topology, Continuity of functions, Homeomorphisms and topological equivalence, Closed and open maps, Connectedness and path-connectedness, Compactness and continuity (extreme value theorem, etc.), Connectedness and Separation, Connected spaces, Separation axioms (T1, T2, T3, T4), Homotopy and Fundamental Groups,Basic concepts of homotopy, Fundamental group, and its Applications in Data Sciences.

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		60
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		
1. Course Laboratory	00	
2. Computer Laboratory	00	

3. Engineering Workshop / Course/Workshop / Kitchen	00	05

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		**60**

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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

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. Introductory functional analysis with applications. (https://docs.ufpr.br/~eidam/2019/2/CM075/Kreyszig.pdf)
2. Topology; a first course Book by James Munkres (http://www.alefenu.com/libri/topologymunkres.pdf)
3. Schaum's Outline of Linear Algebra (http://www.astronomia.edu.uy/progs/algebra/Linear_Algebra,_4th_Edition_(2009)_Lipschutz-Lipson.pdf)
4. Mathematical Analysis - S. C. Malik, Savita Arora (https://teachmint.storage.googleapis.com/public/455183762/StudyMaterial/e7961b50-8346-4174-a93e-1fc3d9aefce1.pdf)

10.Course Organization

Course Code	DSC501A		
Course Title	Advanced Mathematics for Data Science		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

Associate Professor and HOD
Depar... Sciences and Analytics
...cial Sciences
M... ...ity of Applied Sciences
...u – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru-560 054

Approved by the Academic Council at meeting held on March 2024

Course Specifications: Database Management Systems and Advanced SQL

Course Title	Database Management Systems and Advanced SQL
Course Code	DSC503A
Course Type	Theory + Practical
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	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes (COs)

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

1. **CO-1:** Understand foundational database concepts, architectures (client-server, distributed, cloud), data models, and normalization techniques, and apply SQL commands to design and implement efficient database schemas.

2. **CO-2:** Analyze and execute complex SQL queries, including joins, sub queries, indexing, and optimization techniques, and demonstrate advanced SQL operations such as window functions, transactions, and concurrency control.
3. **CO-3:** Design secure, optimized database systems by implementing constraints, encryption, backup and recovery strategies, and replication techniques. Evaluate database performance using tuning and monitoring strategies.
4. **CO-4:** Apply advanced SQL techniques for data analytics, integrate SQL databases with BI tools, and utilize vector databases for similarity search and recommendation systems using embeddings and advanced indexing techniques.

4. Course Contents

Module 1: Database Foundations

Introduction to DBMS and Databases, Database Architecture: Client-Server, Distributed, and Cloud Databases, Data Models: Hierarchical, Network, Relational, Object-Oriented, Entity-Relationship (ER) Modeling: Entities, Relationships, Attributes, Keys, Normalization: First to Third Normal Forms, BCNF, SQL Basics: DDL, DML, DCL Commands.

Module 2: Advanced SQL Techniques

Complex Queries: Joins, Sub queries, Unions, and Set Operations, Functions in SQL: Aggregate, Scalar, Window Functions, Indexing and Query Optimization Techniques, Transactions and Concurrency Control: ACID Properties, Isolation Levels, Triggers, Views, and Stored Procedures, Working with JSON in SQL

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

Module 3: Database Design and Management
Database Design Process: Requirement Analysis, Logical and Physical Design, Data Integrity and Security: Constraints, Encryption, User Roles, Backup and Recovery Strategies, Users and Privileges Management, Database Tuning and Performance Monitoring, Database Replication

Module 4: Data Analytics with SQL
Introduction to Data Analytics: Concepts, Tools, and Techniques, Advanced SQL for Analytics: CTEs, Window Functions, Pivoting Data, Data Cleaning and Preparation with SQL, Data Aggregation and Reporting, Integration of SQL with BI Tools: Power BI, Tableau, Optional: Predictive Analytics using SQL

Module 5: Vector Databases

Introduction to Vector Databases, Definition and Purpose, Use Cases: Similarity Search, Recommendation Systems, Semantic Search, Core Concepts: Vectors and Embeddings, Similarity Measures: Cosine Similarity, Euclidean Distance, Key Features of Vector Databases, Indexing Techniques: ANN, Exact Nearest Neighbor, Scalability: Handling Large Datasets, Performance Considerations

Popular Vector Databases:
Pinecone, Weaviate, Milvus

Practical Applications:
Integration with Applications: APIs, Real-World Examples, Use Case Examples: Similarity Search, Recommendation Systems

Hands-On Lab:
Basic Operations: Inserting and Querying Vectors, Simple Example Project: Application Setup and Implementation

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	2	2	1	1	2	2	3	2	1
CO-2	3	3	2	3	3	2	1	2	3	3	3	2

CO-3	2	2	2	2	3	3	1	3	2	2	2	2
CO-4	3	3	2	3	3	2	1	3	3	3	3	3
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		35
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	35	
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	
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

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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 (60% Weightage)			Component 2: SEE (40% Weightage)
Subcomponent ▸	SC1	SC2	SC3	
Subcomponent Type ▸	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▸	20	20	20	
CO-1				
CO-2				
CO-3				
CO-4				
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

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

A. Essential Reading

10. Course Organization

Course Code	DSC503A	
Course Title	Database Management Systems Advanced SQL	
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 specification: Advanced Statistics

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Course Title	Advanced Statistical Method
Course Code	DSC502A
Course Type	Theory + Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Size and Credits

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
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 Summary:

Statistical methods used in practice are based on a foundation of statistical theory. One branch of this theory uses the tools of probability to establish important distributional results that are used throughout statistics. Another major branch of statistical theory is statistical inference. It deals with issues such as how do we define a "good" estimator or hypothesis test, how do we recognize one and how do we construct one? This course is concerned with the fundamental theory of random variables and statistical inference.

Pre-Requisite: Basic Calculus, Linear Algebra and Statistics

3. Course Outcomes:

After the end of the course, students will be able to:

CO1:Define some basic concepts and notations in Advance statistics
CO2:Discuss quantitative and qualitative approaches in Advance statistics
CO3:Solve different types of problems involving the concepts of Advance statistics
CO4:Analyze data for the further references
CO5:Evaluate the problems involving the concepts of statistical inferences.

4. Course Contents

UNIT I

Introduction to Statistics
Introduction: Statistics, Frequency distribution
Measures of central tendency: Mean, Median, Mode- Data Science examples
Measures of dispersion: Dispersion, Range, standard deviation, Data Science problems
Correlation: Definition, Karl Pearson's coefficient of correlation, multiple correlation - Data Science examples

UNIT II
Probability Theory:

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions; expectation and moments. Independent random variables, Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.e. case).

UNIT III
Concepts of Statistical Distribution:

Probability mass function, Cumulative distribution function, Moments, Expectation and Variance, Moment Generating function, Characteristic function. Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance, Uniform, Normal, Exponential and Weibull distributions, Joint distribution and joint density functions, Conditional distribution and density function.

UNIT IV
Sampling Techniques and Sampling Distribution:

Basic concepts of sampling from a finite population; sampling versus complete enumeration; simple random sampling; sample size determination; stratified random sampling; systematic sampling; cluster sampling and multi – stage sampling (all sampling schemes without proof of expressions). Sampling distributions, standard errors and asymptotic distributions.

UNIT V
Statistical Inference- Theory of Estimation:

Estimation methods of maximum likelihood, Method of moment's estimation. Minimum variance unbiased estimators. Minimum variance bound estimators. Cramer-Rao Inequality. Sufficient Statistics. Factorization theorem. Complete Statistics. Rao-Blackwell theorem. Confidence interval estimation.

UNIT VI
Statistical Inference- Hypothesis Testing:

Simple and composite hypotheses. Two kinds of error. Critical region. Different types of critical regions and similar regions. Power function. Most powerful and uniformly most powerful tests. Neyman-Pearson fundamental lemma. Unbiased test. Randomized test. Likelihood ratio test. One sample and two sample mean test, test for variance, one way ANOVA.

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	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
CO-5	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		60
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		
1. Course Laboratory	00	

2. Computer Laboratory	05	10
3. Engineering Workshop / Course/Workshop / Kitchen	05	

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	05	
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		**60**

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	

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.

8. 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:

Text books:

1. **"Fundamentals of Statistics, Vol. 1"**, Goon, A.M., Gupta, M.K. & Dasgupta B, World Press, 2016.
2. **"An Introduction to Probability Theory and Mathematical Statistics"**, Rohatgi, V.K. & Saleh, Wiley Series, 2nd Edition.

References Books:

3. **"Probability and Statistical Inference"**, R.V. Hogg, A. Craig, 6th .Ed.Pearson Education. 2006
4. **"Mathematical Statistics with Applications"**, I. Miller, M. Miller, Pearson Education. 2006

10. Course Organization:

Course Code	DSC502A	
Course Title	AdvancedStatistics Methods	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Title	Fundamentals in Programming
Course Code	DSC511A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course summary:

The course provides a comprehensive introduction to Python programming, focusing on core concepts essential for data science workflows. It emphasizes problem-solving, logical thinking, and structured coding, enabling students to develop foundational skills, apply programming constructs,work with libraries for data handling and analysis, and design modular, reusable programs through hands-on exercises and case studies.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	2:0:4
Total Hours of Interaction	90
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)

At the end of the course, students will be able to:

CO1: Demonstrate foundational understanding of Python programming concepts and the structure of Python programs.

CO2: Apply programming constructs and logical reasoning to develop, test, and debug Python programs effectively.

CO3: Utilize programming paradigms, libraries, and tools to process, manipulate, and analyze data, and evaluate program correctness.

CO4: Design and implement modular, structured, and reusable Python programs to solve complex problems

4. Course Contents

Unit 1: Foundations of Python

Introduction to Python: Python Distributions – CPython, Anaconda, Miniconda; IDEs for data science workflows; Working with virtual environments – venv, conda env; Variables and assignment rules; Keywords, operators in Python; Data types; Indentation and comments; Input/output techniques – f-strings, eval(); **Type conversions** – implicit and explicit casting; Basic debugging using print statements; Common syntax and runtime errors; **Python built-in data structures** – Lists, Tuples, Sets, Dictionaries.

Hands-on: Implement Python programs to reinforce foundational concepts and develop structured problem-solving skills in a chosen domain.

Unit 2: Python Control Flow and Functions

Iterators and iterables; **Conditional statements** – if, elif, else; range(); **Loops** – for, while; **Loop control statements** – break, continue, and pass; **User-defined functions** – defining and calling functions, return statement, parameters and types of arguments, scope and lifetime of variables (local and global), lambda functions; **Exception handling** – try–except block, handling multiple exceptions, finally.

Hands-on: Develop Python programs applying control structures, functions, and exception handling to solve complex, domain-specific tasks.

Unit 3: Modules and Packages

Built-in modules – math, random, datetime, os, sys; **User-defined modules** – creating a .py module, importing and using functions across files; **Packages and imports** – package structure (__init__.py), import variations; **Package installations** – installing external packages using pip, version management (pip show, pip freeze).

Hands-on: Create and utilize Python modules and packages, including built-in and external libraries, to build modular and reusable solutions in the chosen domain.

Unit 4: Introduction to OOPs

Class and Object Basics: Defining classes, creating objects, Class attributes vs instance attributes; **Methods**: Instance methods, use of self, special method __init__() (constructor); **OOP Principles- Inheritance:** single, multiple, multilevel; Method overriding in subclasses, **Encapsulation:** public, protected, private attributes, **Abstraction:** concept and simple examples (with abstract base classes); **Polymorphism:** method overloading (conceptual), overriding, operator overloading basics.

Hands-on: Design and implement Python classes to demonstrate object-oriented programming principles in domain-specific scenario.

Unit 5: File Handling in Python

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

File Handling - Types of Files: text vs binary; Opening, reading (read(), readline(), readlines()),writing, and closing files; **File modes:** r, w, a, rb, wb; Handling file exceptions.
CSV Handling - Introduction to structured data, Reading CSV files using built-in csv module, Writing data to CSV files.

Hands-on: Develop programs to efficiently read, write, and manipulate text and CSV files, including handling exceptions and structured data for domain-specific application.

Unit 6: Introduction to Libraries for Data Science
NumPy Basics: Creating arrays, Indexing and slicing arrays, **Basic array operations**: addition, multiplication, aggregation functions (sum, mean, max).
Pandas Basics: Creating Series from lists and dictionaries, Accessing elements by index and label., Basic operations on Series (addition, filtering).
Hands-on: Build programs to perform efficient numerical computations with NumPy and analyze labeled data using Pandas Series for domain-specific scenarios

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	1		1	1	1			2	3	2	2
CO-2	3	2	1	2		2			2			
CO-3	3	2	1	2	2	2		2	2	3	3	2
CO-4	3	3	2	3	3	3		2	3	3	3	3
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		25

Demonstrations		
1. Demonstration using Videos	00	10
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		
1. Solving Numerical Problems	00	00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	40	
3. Lab	00	40
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	10
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**90**

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 M.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

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

		Component 1: CE (60% Weightage)						Component 2: SEE (40% Weightage)
Subcomponent ▸	**SC1**	**SC2**	**SC3**	**SC4**	**SC5**	**SC6**		
Subcomponent Type ▸	**Term Test 1**	**Term Test 2**	**Seminar**	**Lab test**	**Lab work**	**Assignment**		**50 Marks**
Maximum Marks ▸ weightage	**5**	**5**	**10**	**20**	**10**	**10**		
CO-1	5			10	2			10
CO-2				10	4			10
CO-3		5			2	5		15
CO-4			10		2	5		15
The details of SC1, SC2 or SC3 are presented in the programme Specification 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

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	Lab Work
4.	Analytical Skills	Lab Work
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Lab activities, Case study
7.	Group Work	Assignment
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination

10.	Verbal Communication Skills	
11.	Presentation Skills	Mini Project
12.	Behavioral Skills	
13.	Information Management	Assignment
14.	Personal Management	
15.	Leadership Skills	

9. Course Resources

Essential Readings

1. "*Fluent Python: Clear, Concise, and Effective Programming*"by Luciano Ramalho, 2nd Edition, O'Reilly, 2022
2. "*Python Crash Course: A Hands-On, Project-Based Introduction to Programming*"by Eric Matthes, 2nd edition, No Starch Press.
3. "*Python Crash Course: A Hands-On, Project-Based Introduction to Programming*" by Eric Matthes, 2nd edition, No Starch Press.
4. "*Python for Data Analysis*" by Wes Mckinney, 3rd edition, O'Reilly 2022
5. "*Learning Python*" byMark Lutz 4th edition, O'Reilly

Reference Books:

1. "*Automate the Boring Stuff with Python, 2nd Edition: Practical Programming for Total Beginners*" by Al Sweigart, No Starch Press, 2019
2. "*Python: The Complete Reference*" by Martin C. Brown, 4th Edition, McGraw Hill Education, 2022
3. "*Programming and Problem Solving with Python"* by Ashok Namdev Kamthane and Amit Ashok Kamthane, 2nd Edition, McGraw Hill Education

10.Course Organization

Course Code	DSC511A	
Course Title	Foundations in 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		

Course Specifications: Econometrics for Data Science

Course Title	Econometrics for Data Science

Approved by the Academic Council at meeting held on March 2024

Course Code	DSC505A
Course Type	Core: Theory + Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary:

The course aims to develop competence in a set of techniques that are used to estimate and test economic relationships. The methods taught here can be employed in the business and social science disciplines. The emphasis of this course will be on formulating econometric models to analyze data, establish inter-relationship and address real-life decision problems.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes (COs)

At the end of the course, students will be able to:

CO-1: Understand the concept of measurement in econometrics and structure of econometric data.

CO-2: Develop regression models and handle violations in the context of economic applications

CO-3: Synthesize the suitable modelling techniques including panel data techniques in empirical modelling using hands-on software

CO-4: Learn fundamentals of econometric modelling of time series data.

4. Course Contents:

Unit 1: Introduction to Econometrics: Nature, scope, objectives and methodology of econometrics; steps in empirical economic analysis, distinction between Economic Model and Econometric model; Types of econometrics, mathematical and statistical pre-requisites, the structure of economic data: Cross-section, time series, panel and pooled cross-sectional data.

Unit 2: Single Equation Regression Model: Two-variable regression analysis, Classical Normal Linear Regression Model, Interval Estimation and Hypothesis testing, Goodness of fit; Multiple Regression Analysis- Estimation, Tests of significance for regression parameters, the assumptions of classical model – testing and validation, Use cases.

Unit 3: Simultaneous Equation Models: The nature of simultaneous equation models, recursive models and ordinary least squares, Method of Indirect Least Squares, Method of Two-stage Least Squares, Simultaneous equation bias, Estimation of standard errors, Financial applications – use cases.

Unit 4: Panel data models: Understanding panel data, Estimation of Panel data regression models, Simple panel data models - pooling Independent Cross Sections across Time

Advanced panel data models (Static)- The Fixed-effects approach, Least Squares Dummy Variable (LSDV) Model, Other key model variations, The Random effects approach, Comparison between the approaches; Advanced Panel Data Models (Dynamic)- Dynamic panel data (DPD) setup, Correlation lagged dependent variable and the error term (Nickell bias), Anderson and Hsiao estimation, Arellano and Bond estimation, System vs. Difference GMM estimation

Unit 5: Time Series Econometrics: Introduction to time series, components, Stochastic processes, trend stationary vs. difference stationary, Tests of stationarity, The Unit Root test, Transformation of Non-stationary series, Co-integration and testing, Economic applications – use cases.

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	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												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		60
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		5
1. Course Laboratory	00	
2. Computer Laboratory	05	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	05	
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**

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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

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:

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

10. Course Organization

Course Code	DSC505A		
Course Title	Econometrics for Data Science		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			

Approved by the Academic Council at meeting held on March 2024

Next Course Specifications Review Date	

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Specifications: Spreadsheet Analytics

Course Title	Spreadsheet Analytics
Course Code	DSL501A

Approved by the Academic Council at meeting held on March 2024

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

Course Type	PRACTICAL
Department	Data Sciences and Analytics

1. Course Summary

The **Spreadsheet Analytics** course provides a comprehensive exploration of Excel's advanced functionalities for data management and analysis. Starting with foundational skills in data entry, formatting, and cleaning, students will progress to mastering advanced formulas such as nested functions and lookups to solve complex data retrieval challenges. The course covers data visualization techniques, focusing on creating interactive dashboards and applying conditional formatting for insights. Students will also learn to automate repetitive tasks using Excel macros and VBA, enhancing workflow efficiency. Advanced modules include data modeling with Power Query and Power Pivot, as well as integrating Excel with external data sources. Emphasis is placed on ethical data handling and security, with practical projects embedded throughout to reinforce problem-solving in real-world scenarios.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
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: Analyze and Interpret Data: Students will be able to apply advanced Excel functions and tools to analyze and interpret large datasets effectively.

CO-2: Design Interactive Dashboards: Students will create dynamic dashboards that present key performance indicators and data trends visually.

CO-3: Automate Tasks: Students will demonstrate the ability to automate repetitive tasks using Excel macros and VBA, increasing efficiency in their workflows.

CO-4: Solve Complex Problems: Students will apply critical thinking and problem-solving strategies to tackle complex data-related challenges using Excel.

4. Course Contents

Module 1: Excel Fundamentals and Data Management

Understanding Excel Interface, Data Entry and Formatting, Data Types and Validation, Basic Functions and Formulas, Data Cleaning Techniques, Identifying and removing duplicates, using text functions (TRIM, LEFT, RIGHT, MID), Handling missing data, Problem-Solving Focus: Develop skills to clean and organize data effectively.

Module 2: Advanced Formulas and Functions

Nested Functions, Array Formulas and Dynamic Arrays, Error Handling Techniques, Lookup Functions (VLOOKUP, HLOOKUP, INDEX, MATCH), Problem-Solving Focus: Solve complex data retrieval problems using advanced functions.

Module 3: Data Analysis and Visualization Techniques

Data Analysis Tools (What-If Analysis, Goal Seek), Data Visualization Techniques, Creating Advanced Charts and Graphs, Using Conditional Formatting for insights, Dashboarding, Principles of effective dashboards, creating interactive dashboards with Excel, utilizing slicers and timelines for data interaction, Problem-Solving Focus: Use visualization to derive insights and present data clearly.

Module 4: Data Analysis with Took Pak

Descriptive Statistics Tool, Creating Histograms, Percentile Ranking, Calculating Moving Averages, Exponential Smoothing, Random Number Generation, Data Sampling, Inferential Statistics Tools, Analysis of Variance (ANOVA), Optimization Modeling with Solver.

Module 5: Automating Tasks with Macros and VBA

Introduction to Macros, Basic VBA Programming, Creating and editing macros, Writing User-Defined Functions, Error Handling in VBA, Implementing Automation in Repetitive Tasks, Problem-Solving Focus: Automate data tasks to improve efficiency and accuracy.

Module 6: Advanced Data Modeling and Business Intelligence: Power Query for Data Transformation, Power Pivot for Data Modeling, DAX (Data Analysis Expressions), Integrating Excel with Other Applications, Importing data from SQL, Exporting Excel data to other formats,

Data Protection and Security, Protecting worksheets and implementing user permissions, Best Practices in Data Handling and Ethics, Problem-Solving Focus: Build robust data models and ensure ethical data practices.

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	3	1	2	2	1	1	2	2	3	2	1
CO-2	2	2	2	1	3	2	1	2	2	3	3	2
CO-3	2	1	1	1	2	3	1	1	2	2	2	3
CO-4	3	3	2	2	2	2	2	2	3	2	3	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		60
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		
Practical Work		
1. Course Laboratory	60	
2. Computer Laboratory	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		60

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

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

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

1. https://www.sgul.ac.uk/about/our-professional-services/information-services/library/documents/training-manuals/Excel-Fundamentals-Manual.pdf
2. W3schols EXCEL material
3. Microsoft Excel Documentation
4. ExcelJet website resources etc.

10. Course Organization

Course Code	DSL501A
Course Title	Spreadsheet Analytics

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

◂◆

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Assoc
Departme
Sc
M S Ramaiah U
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

SEMESTER 2

Course Specifications: Data Acquisition and Data Pre-processing

Course Title	Data Acquisition and Data Pre-processing
Course Code	DSC507A

Approved by the Academic Council at meeting held on March 2024

Course Type	Core Theory + Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course introduces learners to the essential processes involved in acquiring, preparing, and understanding data for analysis. It covers methods for obtaining data from various sources, refining and transforming raw datasets, and exploring data through visual and statistical techniques. Students will gain practical experience in organizing, cleaning, and extracting meaningful information from real-world datasets. By the end of the course, learners will be able to construct a complete data preprocessing workflow that supports effective data-driven decision-making.

2. Course Size and Credits

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcome (COs)

At the end of this course, the student will be able to:

CO1: Understand the fundamental concepts and processes involved in acquiring and preparing data for analysis.

CO2: Apply appropriate techniques to organize, refine, and explore datasets in order to improve their quality and usability.

CO3: Analyze data characteristics, patterns, and relationships to support meaningful interpretation and decision-making.

CO4: Create a data processing workflow that integrates acquisition, preparation, and exploratory analysis for real-world problem scenarios.

Asso
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

4. Course Content

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Unit 1: Data Acquisition Fundamentals
Types of Data: Structured, Semi-structured, Unstructured; **Data Sources:** Databases, API's, Websites, Sensors/IoT, Logs, Social-Media; **Data Collection Methods:** Manual acquisition, Automated workflows; **Web Scraping Basics:** HTML structure.

Unit 2: Data Handling with Pandas
Creating DataFrames from files, APIs, dictionaries; Indexing, Subsetting, Row/Column Selection; **DataFrame Operations:** Dropping, Renaming, Sorting, Filtering and Conditional Selection; **Combining Data:** Merge, Join, Concatenation; **GroupBy Operations:** Aggregations, summary statistics; Pivot Tables and Cross-tabulation, Working with Datetime Data.

Unit 3: Data Visualization
Matplotlib: Line Plot, Bar Chart, Scatter Plot, Histogram, Pie Chart, Subplots and layout options; **Seaborn:** Distribution Plots – distplot, kdeplot, histplot; Box Plot, Violin Plot, Pair Plot, Heatmap, Count Plot, Bar Plot, Cat Plot; **Plotly:** Interactive Visualization.

Unit 4: Data Cleaning:
Fixing Rows and Column Issues: renaming, rearranging, stripping spaces; **Handling Missing Values:** Mean, Median, Mode imputation, Forward/Backward fill, Dropping missing records; **Handling Outliers:** Z-score, IQR; Removing Duplicates, Fixing Invalid/Inconsistent Data, Standardization and Normalization, **Encoding Categorical Variables:** Label Encoding, One-Hot Encoding, Binning and Discretization, Filtering and Subsetting Data.

Unit 5: Feature Extraction
Univariate Analysis: numeric & categorical variables; **Bivariate Analysis:**
Numeric–Numeric: correlation, scatter analysis, **Categorical–Categorical**: contingency tables, chi-square – conceptual, **Numeric–Categorical:** ANOVA;
Multivariate Analysis: pair plots, heatmaps; Correlation vs. Causation
Feature Engineering Basics: new variable creation, transformations;
Multicollinearity: correlation matrix, VIF.

Unit 6: Feature Selection
Feature Selection Techniques: Filter methods -correlation, chi-square, Wrapper methods forward/backward selection;
Introduction to Dimensionality Reduction: PCA

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	1	1								1		
CO-2	2		2								2	
CO-3		2		2						2	2	
CO-4					3	3			3			3
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		**30**
Demonstrations		**10**
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		
1. Solving Numerical Problems	00	
Practical Work		**30**
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

Approved by the Academic Council at meeting held on March 2024

Associate Professor & HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560 054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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	**05**
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		
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 (60% Weightage of total 100 marks)			**Component 2: SEE (40%**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	

				Weightage of total 100 marks)
Subcomponent Type ▸	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▸	20	20	20	
CO-1				
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 thebeginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

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

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

9. Course Resources

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Essential Readings

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

1. "*Python for Data Analysis*" by Wes Mckinney, 3rd Edition, O'Reilly, 2022
2. "*Feature Engineering for Machine Learning: Principal and Techniquues for Data Scientists*" by Alice Zheng and Amanda Casari, O'Reilly.
3. "*Python Data Science Handbook:*" by Jake VanderPlas, O'Reilly
4. "*Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*" by Aurelien Geron, O'Reilly/
5. "*Practical Statistics for Data Scientists*" by Peter Bruce, Andrew Bruce, and Peter Gedeck, O'Reill

10.Course Organization

Course Code	DSC507A	
Course Title	Data Acquisition and 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		

Course Specifications: Advanced Machine Learning

Course Title	Advanced Machine Learning
Course Code	DSC508A

Course Type	Core Theory + Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course covers a comprehensive journey through the world of Machine Learning. In the first unit, students learn the foundations of ML, understand 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. Finally, the unit ends with the introduction of Deep learning (Artificial Neural Network)

2. Course Size and Credits

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes (COs)

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

- CO1. Understand machine learning and theoretical as well as practical applications of different algorithms of Regressions
- CO2. Understand theoretical as well as practical applications of different algorithms of Classification

- CO3. Understand theoretical as well as practical applications of different algorithms of clustering along with hands-on activities using state-of-art algorithms from sklearn
- CO4. Understand evaluation matrix of model performance, regularization, optimization, Deployment of model. Introduction of Deep learning, Artificial Neural network.

4. Course Contents

Unit 1: Applications of Machine Learning, Perspectives and issues in machine learning, Confusion Matrix, Precision, Recall, F1-score, Bias-Variance, Overfitting and Underfitting, ROC, AUC. Linear regression, Gradient Descent, Multiple linear regression, Logistic Regression, Regularization, ridged(L2) and Lasso(L1) Regularizes.

Unit 2: Decision tree, Entropy, Gini impurity, Information Gain, Random Forest, Support Vector Machine, k-nearest neighbor, Bagging and Boosting, Stacking, AdaBoost, XGBoost. Bayes' Theorem, Naïve Bayes Classifier, Applications of Naïve Bayes in text classification and spam filtering, Basics of Bayesian networks.

Unit 3: k-means, density-based clustering method (DBSCAN), Hierarchical clustering (single, average, and complete linkages), Performance analysis of clustering algorithms, dimensionality reduction, Principal Component Analysis (PCA), Data visualization after PCA.

Unit 4: Introduction to deep learning, machine learning vs deep learning, applications of deep learning, artificial neural networks (ANN), biological neuron and artificial neuron, perceptron model, architecture of artificial neural networks, forward propagation, loss functions, activation functions, backpropagation algorithm, gradient descent optimization, overfitting and underfitting, convolutional neural networks (CNN), motivation for CNNs, convolution operation, pooling layers, fully connected layers, applications of CNNs, recurrent neural networks (RNN), sequence modeling, RNN architecture, backpropagation through time, vanishing gradient problem in RNNs, overview of LSTM and GRU, applications of RNNs.

Hands On: Sklearn, TensorFlow, Applications of ANN, CNN, and RNN on real world image recognition, finance, Anomaly Detection.

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	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												

6. 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	0	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		10
1. Course Laboratory	10	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
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**

7. Course Assessment and Reassessment

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	40 Marks
Maximum Marks ▸	20	20	20	
CO-1				
CO-2				
CO-3				
CO-4				
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

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

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
5. Shai Shalev-Shwartz, Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms.
6. https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf
7. Zhang et. al. Drive into Deep Learning. https://d2l.ai/
8. Deisenroth et. al. Mathematics for Machine Learning. https://mml-book.github.io/book/mml-book.pdf

10.Course Organization

Course Code	DSC508A	
Course Title	Advanced 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		

Approved by the Academic Council at meeting held on March 2024

Associate Professor
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Specifications: Optimization Methods and its Applications

Course Title	Optimization Methods and it's Applications
Course Code	DSC509A
Course Type	Core Theory +Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This optimization course is designed to provide students with expertise in both linear and nonlinear programming techniques. Students will learn to formulate and solve Linear Programming Problems (LPP) using graphical methods, the Simplex method, and advanced techniques such as the Dual Simplex Method and Big-M Method. They will develop skills in tackling Nonlinear Programming Problems (NLPP) with nonlinear objective functions and constraints using graphical methods. Additionally, students will acquire proficiency in implementing advanced optimization techniques including the Gradient Descent Method, Newton's Method, Lagrange Multiplier Method, and Kuhn-Tucker Conditions (KKT) for optimizing complex objective functions under various constraints. The course will also cover heuristic and metaheuristic approaches such as Simulated Annealing, Tabu Search, Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Gravitational Search Algorithms (GSA) for solving optimization problems in infinite-dimensional spaces, preparing students for practical applications across engineering, economics, and beyond.

2. Course Size and Credits:

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes (COs)

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

1. Gain expertise in formulating and solving Linear Programming Problems (LPP) using graphical methods, the Simplex method, and advanced techniques like the Dual Simplex Method and Big-M Method.
2. Develop skills in formulating and solving Nonlinear Programming Problems (NLPP) with nonlinear objective functions and constraints using graphical methods.
3. Acquire proficiency in implementing the Gradient Descent Method, Newton's Method, Lagrange Multiplier Method, and Kuhn-Tucker Conditions (KKT) for optimizing complex objective functions under constraints.
4. Understand and apply heuristic and metaheuristic approaches like Simulated Annealing, Tabu Search, Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Gravitational Search Algorithms (GSA) in solving optimization problems in infinite-dimensional spaces.

4. Course Contents

Unit 1: Linear Programming Problem (NLPP)

Evolution and definitions of OR, Scope and applications of OR (e.g. optimizing Machine learning models for social science and supply chain related problems), Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables). Simplex method, Solutions to LPP by Simplex method, Big-M Method and Two-Phase Simplex Method,

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

Unit 2: Nonlinear programing problem

Definition and applications of nonlinear optimization, Differences between linear and nonlinear optimization, Examples of real-world problems involving nonlinear optimization, Introduction to nonlinear objective functions, Examples of nonlinear objective functions in optimization problems, Examples of nonlinear constraints in optimization problems, Types of constraints: equality and inequality constraints, Representation of nonlinear constraints in Euclidean space, Solution of NLPP by graphical method.

Unit 3: Nonlinear Optimization techniques

Gradient Descent Method, Newton's Method, Penalty Methods, Lagrange Multiplier Method, Concept and purpose of Lagrange multipliers, Necessary conditions for optimality by LMM, Introduction to Kuhn-Tucker Conditions (KKT) Conditions, Definition and significance, General form of KKT conditions, Deriving KKT conditions from the Lagrangian, Interpretation of KKT conditions in optimization problems.

Unit 4: Infinite Dimensional Optimization

Introduction to infinite-dimensional optimization, focusing on spaces with infinitely many dimensions, such as function spaces. Heuristic and metaheuristic approaches, including single solution approaches like Simulated Annealing and Tabu Search, as well as population-based approaches such as Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Gravitational Search Algorithms (GSA).

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		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		30
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**

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.

Approved by the Academic Council at meeting held on March 2024

Associate Professor
Department of Data Science
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40**
Maximum Marks ▸	**20**	**20**	**20**	**Marks**
CO-1				
CO-2				
CO-3				
CO-4				
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

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 Resource

Reference Books:

1. "Operations Research: An Introduction" by Taha, Hamdy A.
2. Convex Optimization" by Stephen Boyd and Lieven Vandenberghe (https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf)
3. "Essentials of Metaheuristics" by Sean Luke (https://cs.gmu.edu/~sean/book/metaheuristics/Essentials.pdf)

10.Course Organization

Course Code	DSC509A		
Course Title	Optimization Methods and it's Applications		
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: Introduction to Geo informatics

Course Title	Introduction to Geo informatics
Course Code	DSE501A
Course Type	Theory and Lab
Department	Department of Data Science and Analytics

Approved by the Academic Council at meeting held on March 2024

Associate Profes... Department of Data Scie... School of Social Sciences M S Ramaiah University of Applied Sciences Bengaluru – 560054

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

Director School of Social Sciences M S Ramaiah University of Applied Scie... Bengaluru – 560054

Faculty	School of social sciences

1. Course Summary:

This course aims to provide the students with an advanced understanding of the theory and application of Remote Sensing and GIS technologies. The course will emphasize spatial data analysis, remote sensing image processing. Students will also gain practical experience using advanced GIS software and remote sensing tools.

2. Course Size and Credits:

Number of Credits	3
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
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):

By the end of the course, students will be able to:

CO-1: Grasp the basics of electromagnetic radiation, sensor types, and how remote sensing data is collected and processed.

CO-2: Master advanced remote sensing techniques and perform advanced data analysis and interpretation of satellite and airborne remote sensing data.

CO-3: Understand the foundational concepts of GIS, including spatial data types, coordinate systems, and data structures.

CO-4: Utilize GIS software to create, manipulate, and analyze geospatial data.

4. Course Contents:

Unit 1. Introduction to Remote Sensing (RS):

- Definition and history of remote sensing – Remote sensing process
- Types of remote sensing platforms (satellite, airborne, UAVs)
- Types of sensors (active vs. passive, optical, infrared, microwave)

- Remote sensing data types: imagery, LiDAR, radar, etc.

Unit 2: Introduction to Geographic Information Systems (GIS):

- Definition and history of GIS
- Components of GIS: hardware, software, data, people, and procedures
- GIS data models: raster vs. vector data
- Basic concepts: spatial analysis, cartography, and geospatial data management

Unit 3: Principles of Remote Sensing

- Data: In-situ & remotely sensed data – Electromagnetic radiation - Electromagnetic spectrum – Interaction with atmosphere: absorption, scattering, refraction, reflection.
- Understanding visible, infrared, and microwave radiation - Spectral signatures and their interpretation
- Remote sensing platforms: Satellite systems (e.g., Landsat, Sentinel, MODIS)

Unit 4: Remote Sensing Sensors, Image Acquisition and Preprocessing:

- UAV-based remote sensing
- Sensor types: multispectral, hyperspectral, thermal infrared, and radar
- Image resolution: spatial, spectral, temporal, and radiometric
- Image calibration and correction (geometric, radiometric, atmospheric) - Image enhancement techniques

Unit 5: GIS Software and Tools:

- Introduction to popular GIS software (ArcGIS, QGIS, GeoDa)
- Data input and management: data import/export, digitization
- Coordinate Systems and Projections: Georeferencing and coordinate systems: Advanced concepts of geodetic reference systems, UTM, State Plane, and world geodetic systems (e.g., WGS84).

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			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												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		60
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	15	
Practical Work		25
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		**60**

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 M.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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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

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

1. Remote Sensing and GIS, Basudeb Bhatta, Oxford University Press, 2008.
2. https://bhuvan.nrsc.gov.in/home/index.php
3. https://earthexplorer.usgs.gov/

10. Course Organization

Course Code	DSE501A		
Course Title	Introduction to Geoinformatics		
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 Specification: Research Writing/Methodology

Course Code	DSE510A		
Course Title	Research Writing/Methodology		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	

Approved by the Academic Council at meeting held on March 2024

Course Specifications Approval Date	
Next Course Specifications Review Date	

1. Course summary:

This course provides an overview of the methods and practices involved in conducting research. Students will learn how to formulate research questions, design studies, collect and analyze data, and communicate findings effectively.

2. Course size and credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	School of Social Sciences
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:

CO1: Understand the principles of research methodology.

CO2: Develop skills in formulating research questions and hypotheses.

CO3: Learn various data collection and analysis methods.

CO4: Apply ethical standards in research and communicate research findings in a clear and concise manner.

4. Course content:

Unit 1: Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Basic vs. Applied research. Characteristics of scientific method; Understanding the language of research – Concept, Construct, Definition, Variable. Research Process.

Unit 2: Problem Identification and Formulation: Purpose of literature review – Techniques for conducting and synthesizing literature; Research Question – Investigation Question; Measurement Issues, Hypothesis – Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing, Logic & Importance.

Unit 3: Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs –

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director

School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

concept, types and uses. Experimental Design: Concept of Independent & Dependent variables, Confounding variables

Unit 4. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit 5. Measurement: Concept of measurement, Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Unit 6. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample.Probability Sampling Designs-Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample. Non-probability sampling designs – Snowball, Convenience, Purposive, Quota sampling designs.

Unit 7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Unit 8. Ethics in Research and writing research proposal: Ethical issues in research –Informed consent, confidentiality, and responsible conduct; Components of a research proposal; Funding and grant writing basics; Layout of a Research Paper, Journals, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit 9. Use of tools / techniques for Research: Methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for detection of Plagiarism

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	2	2	2	2	2	1	1			
CO-2	3	2	2	2	2	2	2	1	1			
CO-3	3	2	2	2	2	2	2	1	1			
CO-4	3	2	2	2	2	2	2	1	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		25
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	00	
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		10
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Hospital Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**45**

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 (60% Weightage)			Component 2: SEE (40% Weightage)
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

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

5. Course Resource:

Readings:

1. C.R.Kothari (2004). Research Methodology- Methods and Techniques. Publisher: New Age International(P) Limited.
2. Chawla, D., & Sondhi, N. (2016). *Research Methodology: Concepts and Cases* (2nd ed.). Vikas Publishing House.
3. Shanti Bhushan Mishra and Shashi Alok (2017). Handbook of Research Methodology. Publisher: Educreation.

10. Course Organization

Course Code	DSC510A		
Course Title	Research Writing / Methodology		
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: Data Communication and Networking

Course Title	Data Communication and Networking
Course Code	DSE502A
Course Type	Theory

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Department	Data Sciences and Analytics
Faculty	School of Social Sciences

11. Course Summary

The Data Communication and Networking course introduces students to the fundamental principles and technologies behind data transmission, networking, and communication systems. It covers how data is transmitted, received, and managed across networks, including the physical media, protocols, devices, and network architecture. The course focuses on theoretical concepts, enabling students to understand real-world data communication systems and networks.

12. Course Size and Credits:

Number of Credits	3
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
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

13. Course Outcomes (COs)

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

CO-1: Understand the basic concepts of data communication and networking.

CO-2: Configure and troubleshoot network devices and protocols.

CO-3: Apply IP addressing and subnetting techniques effectively.

CO-4: Implement network security measures to protect data communication.

14. Course Contents

Unit 1: Fundamentals of Data Communication

Fundamentals of data transmission, wired and wireless media, digital and analog transmission, data coding techniques, multiplexing, overview on OSI layers and TCP/IP model

Unit 2: Local Area Networks (LANs) and Data Link Layer

Local Area Networks and data link protocols, point-to-point links and sliding window flow control, CSMA/CD, Ethernet, wireless LAN, cellular networks, and advanced multi-user communication (CDMA, SDMA/MIMO), mobility

Unit 3: Internetworking with TCP/IP

Internetworking using TCP/IP: network programming using socket API, network client/server design

Unit 4: Switching and Wide-Area Networks (WANs)

Packet/circuit switching and wide-area networks: store-and-forward networks, source routing, virtual/permanent, circuits and call set-up, LAN/WAN addressing, hop-by-hop vs. end-to-end control

Unit 5: Routing and Transport Protocols

Routing techniques - intra-domain routing (OSPF, RIP), inter-domain policy routing (BGP) and network connectivity. Transport protocols - TCP and UDP, Congestion control, TCP window control, multimedia Streaming.

Unit 6: High-Level Network Services and Security

High-level network services - DNS, HTTP, SMTP, network management (SNMP), network Security

15.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**

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 5

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 05

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

16. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		45
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		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		**45**

17.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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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.

18.Achieving COs

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Analytics
School of Sciences
M S Ramaiah University of Applied Sciences

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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	--

19. Course Resources

1. Data Communications and Networking" by Behrouz A. Forouzan
2. Data and Computer Communications" by William Stallings

20. Course Organization

Course Code	DSC502A	
Course Title	Data Communication and Networking	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Course specification: Project

Course Title	**Project**	
Course Code	DSP501A	
Course Type	Project	

Approved by the Academic Council at meeting held on March 2024

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:

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	
Number of Weeks in a Semester	15
Department Responsible	Data Science
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.

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

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	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												

6. Course Teaching and Learning Methods

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Associate Professor and HOD
Department of Data Science & Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
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		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**

1. 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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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	--

8. Course Resources:

Reference Books:

9. Course Organization:

Course Code	DSP501A	
Course Title	Project	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

SEMESTER 3

Course Specifications: Applied Geoinformatics

Course Title	Applied Geoinformatics
Course Code	DSE603A

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Type	Theory and Lab
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary:

This course focuses on the integration of two key geospatial technologies—Geographic Information Systems (GIS) and Remote Sensing (RS)—to collect, analyze, interpret, and visualize spatial data. These technologies are critical in a wide variety of fields including environmental management, urban planning, agriculture, disaster management, resource management, and more. Students will learn how to handle both geospatial data (GIS) and satellite/aerial data (Remote Sensing) to make informed decisions and solve real-world problems.

2. Course Size and Credits:

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	2:0:4
Total Hours of Interaction	90
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):

By the end of the course, students will be able to:

CO-1: Master advanced remote sensing data interpretation techniques.

CO-2: Conduct sophisticated spatial analysis using GIS software (ArcGIS, QGIS, GeoDa) and integrate remote sensing data.

CO-3: Design, implement, and execute spatial decision support systems for real-world applications.

CO-4: Develop and critically analyze GIS and remote sensing workflows for research and professional practice.

4. Course Content

Unit 1: Geographic Information Systems (GIS) Fundamentals - Spatial Data Models:

- Vector data model: points, lines, polygons - Raster data model: grids and pixels
- Data conversion techniques between vector and raster formats – TIN - DEM
- Spatial data analysis: overlay analysis, proximity analysis, buffering
- Spatial econometrics: Spatial autocorrelation, spatial heterogeneity

Unit 2: Remote Sensing Data Interpretation and Analysis

- Image classification techniques - Supervised classification: training samples, decision trees
- Unsupervised classification: clustering algorithms
- Accuracy assessment and validation of classifications
- Techniques for detecting changes over time (e.g., difference image analysis)

Unit 3: Advanced Remote Sensing Techniques:

- Vegetation indices (NDVI, EVI) and their applications
- Land use/land cover classification
- Monitoring environmental changes (deforestation, urbanization, climate change)
- LiDAR and RADAR Data Processing
- Introduction to Light Detection and Ranging (LiDAR)
- Synthetic Aperture Radar (SAR) data interpretation

Unit 4: GIS and Remote Sensing Applications

- Environmental Monitoring (e.g. Land cover/land use change analysis)
- Urban and Regional Planning (e.g. Urban sprawl analysis)
- Disaster Management and Risk Assessment

Unit 5: Practical Skills and Hands-on Projects

- Using GIS and remote sensing software to collect and process geospatial data
- Real-world projects and case studies (e.g., disaster recovery, land use mapping etc.)
- Creating maps, charts, and reports to communicate findings

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

	Programme Outcomes (POs)	Programme Specific Outcomes (PSOs)

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

	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												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		90
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	15	
Practical Work		45
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		05
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		**90**

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 M.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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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

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

1. Remote Sensing and GIS, Basudeb Bhatta, Oxford University Press, 2008.
2. https://bhuvan.nrsc.gov.in/home/index.php
3. https://earthexplorer.usgs.gov/

10. Course organization

Course Code	DSE603A	
Course Title	Applied Geoinformatics	
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: Multivariate Techniques for Data Science

Course Title	Multivariate Techniques for Data Science
Course Code	DSC602A
Course Type	Core Theory + Practical

Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course provides an in-depth exploration of multivariate statistical analysis, combining theoretical foundations with practical applications. Students will engage with various techniques such as PCA, FA, MDS, Correspondence Analysis, and Cluster Analysis, enabling them to analyze complex datasets effectively. The course emphasizes hands-on practice, allowing students to apply these methods to real-world scenarios and gain valuable experience. By the end of the course, participants will be prepared to tackle diverse analytical challenges in research and industry settings, enhancing their proficiency in data analysis and interpretation.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
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

3. Course Outcomes (COs)

CO1: Develop a Comprehensive Understanding of Multivariate Analysis Fundamentals

CO2: Enhance Data Examination and Preparation Skills

CO3: Master Key Multivariate Techniques

CO4: Apply Specialized Multivariate Methods to Real-World Problems

4. Course Contents

Unit 1

1. Introduction

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Types of variables - Types of analysis and technique selection - Descriptors (mean, covariance matrix) - Variability and distance - Linear dependence

2. Data Examination

Graphical examination - Missing Data - Outliers - Assumptions of multivariate analysis

3. Principal component analysis (PCA)

Introduction - Component computation - Example - Properties - Extensions - Relationship to SVD

4. Factor Analysis (FA)

Introduction - Factor computation - Example - Extensions

Unit 2

5. Multidimensional Scaling (MDS)

Introduction - Metric scaling - Example - Nonmetric scaling - Extensions

6. Correspondence analysis

Introduction - Projection search - Example - Extensions

7. Anova II way

8. Multivariate Analysis of Variance (MANOVA)

Introduction - Computations (1-way) - Computations (2-way)

Unit 3

9. Canonical Correlation Analysis (CCA)

Introduction - Construction of the canonical variables - Example - Extensions

10. Cluster Analysis analysis and Discriminant Analysis

Introduction – Cluster Analysis, Linear Discriminant Analysis

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		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		
1. Case Study Presentation	00	

Approved by the Academic Council at meeting held on March 2024

2. Guest Lecture	00	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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
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

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:

Reference Books:

1. D. JURAFSKY, J.H.MARTIN, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition(3rdEditionDraft), 2019.

2. E. BENDER (2013), Linguistic Fundamentals for NLP, Morgan Claypool Publishers.. 3. J. ALLEN (1995), Natural Language Understanding, Pearson Education, 1995.

10. Course Specifications:

Course Code	DSC602A	
Course Title	Multivariate Techniques for Data Science	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Approved by the Academic Council at meeting held on March 2024

Associate Professor
Department of Data Science & Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course specifications: Big Data and Cloud Technologies

Approved by the Academic Council at meeting held on March 2024

Course Title	Big Data and Cloud Technologies
Course Code	DSC601A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary:

This course provides a comprehensive introduction to the Big Data ecosystem, modern cloud platforms, and scalable data processing frameworks. Students learn foundational concepts such as distributed systems, Hadoop, HDFS, MapReduce, and YARN, followed by hands-on experience with NoSQL databases like MongoDB. The course then explores cloud computing models, Spark architecture, large-scale ETL processing, and cloud storage integrations. Students also gain practical exposure to real-time streaming systems using Kafka and Spark Structured Streaming, workflow orchestration tools, and scalable machine learning using Spark MLlib and cloud-native ML services. In the later modules, governance, privacy, optimization strategies, and cloud cost management are covered. The course concludes with an end-to-end capstone project where learners design, build, and deploy a complete Big Data pipeline on the cloud.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes

By the end of this course, students will be able to:

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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

CO1. Explain the architecture, components, and working principles of Big Data ecosystems, distributed systems, Hadoop, and cloud computing environments
CO2.Apply NoSQL and cloud-based data storage systems to perform data modeling, querying, ingestion, and scalable processing using MongoDB, Spark, and cloud services.
CO3.Design and develop end-to-end data pipelines involving batch and real-time streaming workflows using Kafka, Spark Structured Streaming, and cloud orchestration tools.
CO4.Implement and optimize scalable machine learning, graph analytics, and cloud-native ML workflows while ensuring data governance, compliance, and performance optimization in cloud environments.

4. Course Content:

Unit 1: Big Data Ecosystem

Characteristics & sources of Big Data, V's of Big Data, Distributed systems, GFS, Hadoop ecosystem overview, HDFS: architecture, file storage, read/write operations, rack awareness, HDFS Commands, MapReduce: framework, job scheduling, fault tolerance, YARN: cluster resource management.

Unit 2: NoSQL Databases and its applications

Introduction to NoSQL Databases and MongoDB, Why NoSQL, SQL vs NoSQL, Types of NoSQL Databases & Use Cases, Introduction to MongoDB, Structure of MongoDB, CRUD operations, Querying in MongoDB, Getting the Data, Comparison Operators, Logical Operators, Regular Expressions, Aggregation in MongoDB, Data Modelling in MongoDB, Indexing in MongoDB

Unit 3: Cloud Ecosystem and Spark

Cloud computing foundations, Service models (IaaS, PaaS, SaaS), Deployment models (public, private, hybrid), Elasticity and auto-scaling, Cloud pricing models, Integration of Big Data and Cloud (compute + storage synergy), Cloud storage backbones (AWS S3), Spark architecture (Driver, Executors, Tasks, Stages), SparkContext vs SparkSession, RDDs, DataFrames, Datasets, Spark SQL and Catalyst optimizer (logical vs physical plans), Data formats (Parquet, ORC, Avro, JSON, XML), Integrating with S3, JDBC, MongoDB, Cassandra, Serialization and persistence (Kryo, caching levels), Monitoring Spark jobs (Spark UI, History Server)

Unit 4: Real-Time Data Pipelines & Streaming Analytics

Batch vs streaming, Event time vs processing time, Spark Structured Streaming vs legacy Spark Streaming, Ingestion systems (Kafka, Kinesis, Pulsar), Windowing, Watermarks, Late data

handling, Lambda vs Kappa architectures, Workflow orchestration (Airflow, Luigi, AWS MWAA, GCP Composer)

Unit 5: Scalable Machine Learning, Graph Analytics & Cloud Platforms

Spark MLlib pipelines (feature engineering, classification, regression, clustering), Distributed ML with TensorFlow and PyTorch on Spark, Graph analytics with GraphX and GraphFrames, Managed Spark platforms (AWS EMR, GCP Dataproc, AWS Glue, Databricks), Cloud-native ML services (SageMaker, Vertex AI, Azure ML).

Unit 6: Governance, Optimization & Capstone

Governance, Compliance & Ethics, Data governance frameworks and lineage, Compliance (GDPR, HIPAA, India DPDP Act), Cloud IAM and RBAC, Audit logs, Ethical analytics (fairness, accountability, transparency), Partitioning, Bucketing, Shuffle optimization, Broadcast joins, Caching and persistence strategies, Catalyst optimizer deep dive, Query plan analysis, Resource scaling and cloud cost-performance optimization, Monitoring Spark jobs with Prometheus, Grafana, CloudWatch, Emerging trends (data mesh, federated systems, serverless Spark, GPU/TPU acceleration), Capstone: Design and implement an end-to-end pipeline using public dataset

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

6. Course Teaching and Learning Methods

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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	20	
Numeracy		20
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	15	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		25
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	10	
6. Discussing Possible Innovations	5	
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 (60% Weightage)			Component 2: SEE (40% Weightage)
Subcomponent ▸	SC1	SC2	SC3	
Subcomponent Type ▸	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▸	20	20	20	
CO-1				
CO-2				
CO-3				
CO-4				
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

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	--

Associate Professor and HOD
Department of Data Sciences and Analytics

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

9. Course Resources:

- White, T. *Hadoop: The Definitive Guide* (O'Reilly)
- Chambers, B. & Zaharia, M. *Spark: The Definitive Guide* (O'Reilly)
- Chodorow, K. *MongoDB: The Definitive Guide* (O'Reilly)
- Sadalage, P. & Fowler, M. *NoSQL Distilled* (Addison-Wesley)
- Leskovec, J., Rajaraman, A., & Ullman, J. *Mining of Massive Datasets* (Cambridge UP)
- Kreps, J. *I Heart Logs* (O'Reilly)

10. Course Organizations:

Course Code	DSC601A	
Course Title	Big Data and Cloud Technologies	
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: Computer Vision

Course Title	Computer Vision	
Course Code	DSE604A	
Course Type	Theory + Practical	
Department	Data Sciences and Analytics	
Faculty	School of Social Sciences	

1. Course Summary

This course provides a comprehensive introduction to both classical and modern techniques in computer vision and image processing. It covers the fundamental concepts of image representation, enhancement, feature detection, and segmentation. As students advance, they explore deep learning techniques such as Convolutional Neural Networks (CNNs), generative models like GANs and VAEs, and real-time applications like object detection and motion tracking. Ethical and societal considerations, including bias and privacy concerns in computer vision systems, are also addressed. Students gain hands-on experience through case studies in medical imaging, autonomous vehicles, surveillance, and generative image synthesis.

2. Course Size and Credits:

Number of Credits	4
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
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: Understand Computer Vision Fundamentals
Students will learn the basics of image representation, processing techniques, and key applications like medical imaging, including image enhancement and feature extraction.

CO-2: Apply Advanced Object Detection, Segmentation, and Motion Analysis
Students will implement and optimize deep learning models for object detection (YOLO, Mask R-CNN), image segmentation, and motion analysis techniques (optical flow, stereo vision) for real-time applications.

CO-3: Develop CNN-based Vision Systems and Explore Generative Models
Students will design convolutional neural networks for image classification, apply transfer learning, and explore generative models (GANs, VAEs) for image generation and restoration.

CO-4: Emerging Research Aspects in Computer Vision
Vision Transformers and responsible AI practices in computer vision systems.

4. Course Contents

Unit 1: Introduction to Computer Vision & Image Processing

What is Computer Vision? History and key developments, Application areas (medical imaging, robotics, security, etc.), Image formation and representation (grayscale, color, pixels, etc.), Color spaces and transformations (RGB, HSV, etc.), Histogram equalization, Noise removal using Gaussian and Median filters, Introduction to features in images, Corner detection (Harris, Shi-Tomasi), Key point detection (SIFT, SURF, ORB), Eigenvalue decomposition.

Unit 2: Advanced Image Processing, Segmentation & Object Detection: Deep learning-based detection models (YOLO, SSD, Faster R-CNN), Applications and use cases, Classical techniques (thresholding, region growing). Using OpenCV for real-time video object detection, Optimizing models for real-time inference.

Unit 3: Deep Learning for Vision – Convolutional Neural Networks (CNNs): Basic CNNs (LeNet, AlexNet), Advanced architectures (VGG, ResNet), Image flipping, cropping, scaling, and rotation, creating robust models with augmented data, Self-attention and its impact on CNNs, Autonomous Vehicle Navigation using Image Recognition for Road Signs, Lucas-Kanade and Horn-Schunck methods, Real-world applications (video stabilization, motion tracking), Applications in 3D reconstruction, robotics, AR/VR, Projective geometry and image transformations.

Unit4: Sustainable Aspects of Computer Vision: Sources and types of bias (racial, gender, etc.), Case studies on algorithmic bias, Frameworks for implementing ethical CV systems, Ethical Considerations in Facial Recognition Technologies for Law Enforcement, Vision Transformers

(ViT), Self-Supervised Learning (SimCLR, BYOL), How to read, understand, and critique research papers, landmark research papers in computer vision, Neural Radiance Fields (NeRF), Vision-based Reinforcement Learning, Implementing Vision Transformers for Image Classification.

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

COs	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	1	1	2	3	2	3	2	1
CO-2	3	3	1	2	2	2	1	2	3	3	3	2
CO-3	3	2	1	2	3	2	1	1	2	3	2	2
CO-4	2	3	2	3	3	2	3	3	2	2	3	3
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		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		25
1. Course Laboratory	00	
2. Computer Laboratory	25	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HoD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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	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**		
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**	

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		15
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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

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

1. Forsyth & Ponce, "Computer Vision-A Modern Approach", Pearson Education.
2. M.K. Bhuyan , " Computer Vision and Image Processing: Fundamentals and Applications", CRC Press, USA, ISBN 9780815370840 - CAT# K338147.
3. Richard Szeliski, "Computer Vision- Algorithms & Applications", Springer.

10. Course Organization

Course Code	DSE604A

Course Title	Computer Vision		
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: Generative Artificial Intelligence (Gen AI)

Course Title	Generative Artificial Intelligence (Gen AI)
Course Code	DSC604A
Course Type	Core Theory
Department	Data Sciences and Analytics

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M.S. Ramaiah University of Applied Sciences
Bengaluru – 560054

Faculty	School of Social Sciences

1. Course Summary

This Generative Artificial Intelligence (Gen AI) course delves into the foundational concepts of deep neural networks, including their architecture, training methodologies, and optimization strategies. The course then transitions to exploring recurrent neural networks (RNNs), their applications in sequence modeling, and the challenges associated with training them. It further covers various RNN variants like GRUs and LSTMs, designed to enhance performance in sequence-related tasks.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	1:0:1
Total Hours of Interaction	45
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)

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

Course Outcome: After completing this course the student will be able to

CO1: Understand fundamentals concepts of NLP, vector representation of text, different word embedding models

CO2: Familiarize with different sequence modeling tasks, such as language modeling and sequence generation, and understand the challenges associated with training RNNs.

CO3: Students will be able to implement and evaluate different variants of RNNs, such as GRUs and LSTMs, to improve their performance in sequence modeling tasks.

CO4: Gain understanding of attention mechanisms, transformer model with hands-on implementation and evaluation of fine-tuning of models.

4. Course Contents

Unit 1: Natural Language Processing & Word Embeddings: Introduction to Word Embeddings, Word Representation, using word embeddings, Properties of word embeddings, embedding matrix, Learning Word Embeddings: Word2vec, Negative Sampling, GloVe word vectors Applications using Word Embeddings: Sentiment Classification, Debiasing word embeddings.

Unit 2: Revisiting the Concepts of Deep Neural Network: Revision of the basic concepts of Neural Network, activation function, logistic regression as a basic building block of NN, Cost function, Performance measure, Computational Graph, Forward and Backward Propagation in NN, Optimization function, Vanishing and Exploding Gradient, Regularization Techniques

Unit 3: Recurrent Neural Network and other variations of RNN: Why sequence models and Its applications, Notation, Recurrent Neural Network Model, Backpropagation through time, Different types of RNNs, Language model and sequence generation, Sampling novel sequences, Vanishing gradients with RNNs, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), Bidirectional RNN

Unit 4: Sequence models & Attention mechanism: Various sequence to sequence architectures, Basic Models, Beam Search, Refinements to Beam Search, Error analysis in beam search, BLEU Score, Attention Model Intuition, Attention Model, Intuition of Transformer model, hand on problems on fine tuning of base models using LoRA, QLoRA.

Hands-on:

- Sentiment Analysis using an RNN model: embeddings, tokenization, model architecture, evaluation
- Use a small GPT model to generate to generate text via API or Library
- Implement the attention mechanism, positional encoding and masking
- Fine-tune a small pre-trained model on a custom dataset
- Group project with report submission

Group project with report submission

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		45
Demonstrations		10
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	10	
3. Demonstration on a Computer	04	
Numeracy		10
1. Solving Numerical Problems	5	
Practical Work		20
1. Course Laboratory	04	
2. Computer Laboratory	20	
3. Engineering Workshop / Course/Workshop / Kitchen/Group Project	06	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		5
1. Case Study Presentation	02	
2. Guest Lecture	01	
3. Industry / Field Visit	04	
4. Brainstorming Sessions	01	
5. Group Discussions	00	
6. Discussing Possible Innovations	02	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**45**

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 (100% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment - 1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
CO-1				
CO-2				
CO-3				
CO-4				
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.

Approved by the Academic Council at meeting held on March 2024

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

8. 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, Case study, Seminal Paper reading, Examination
10.	Verbal Communication Skills	Interactive Q&A session in classroom
11.	Presentation Skills	Group Project presentation
12.	Behavioral Skills	Discipline in
13.	Information Management	Assignment, Foundations behind different models, algotithms
14.	Personal Management	--
15.	Leadership Skills	Project presentation

9. Course Resources:

Reference Books:

a. Deep learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville
b. Hands-on Large Language Models by Jay Alammar and Maarten Grootendorst
c. Build a Large Language Model by Sebastian Raschka
d. Videos and reading materials e.g. research article, blogs etc. shared during the course delivery

10. Course organization:

Course Code	DSC604A
Course Title	Generative Artificial Intelligence (Gen AI)

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: Supply chain Management and Analytics

Course Title	Supply chain Management and Analytics
Course Code	DSE601A
Course Type	Discipline Specific Elective

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course provides a comprehensive overview of supply chain management, focusing on the application of analytical methods to address challenges within supply networks. Students will learn to make data-driven decisions that enhance firm success and evaluate supply chain performance using key metrics. The curriculum covers the design of distribution networks, optimization techniques for facility location and capacity allocation, and strategies for managing inventory under uncertainty. Additionally, it emphasizes multi-criterion decision-making, transportation network design, and the application of soft computing techniques to balance supply and demand.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
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)

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

1. Understand fundamental modelling techniques and analytical tools in supply chain management.
2. Learn key components and basics of developing efficient supply networks.
3. Identify and apply key performance measures for evaluating supply chain efficiency and effectiveness.
4. Utilize analytics to optimize supply chain operations and decision-making process. Explore analytics frameworks and design options to optimize distribution networks.

4. Course Contents

CO1: Introduction to supply chain analytics

Introduction to Modelling and Analytics for Supply Chain, Management, Introduction to Modelling and Analytics in Supply Network, Decisions and Performance Measures in Supply Chain, Introduction to Analytics in Supply Chain, Analytics Framework, Design Options for

Distribution Network, Transportation, Northwest Corner Method, Least Cost Method, Vogel's Approximation Method (VAM), Hungarian Algorithm.

CO2: Inventory location and Performance of the entire supply chain

Inventory location models, Inventory layout, Space calculation, Performance of the entire supply chain, Data envelopment analysis, EOQ, Concepts in inventory management, Safety Stock and Reorder Level, Continuous Review System, and Periodic Review System.

CO3: Concepts in inventory management

Transport Costing, Public transport costing, Fixing Fares for public transportation system, foreign trade logistics, Analytical Hierarchy Processing (AHP) Method, Technique of Order Preference by Similarity to Ideal Solution (TOPSIS) Method, TOPSIS and VIKOR Method, VIKOR and ISM Method

CO4: Risk Analytics and Designing the Global Supply Chain

Topics

Risk Analytics in Supply Network Design, Designing the global supply chain: Tax advantages, Designing the global supply chain: Transshipment, Designing the global supply chain: Flexibility & Total Cost, Designing the global supply chain: Echelons

5. 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
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		60
Demonstrations		
1. Demonstration using Videos	00	

Approved by the Academic Council at meeting held on March 2024

Associate Professor and ...
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

2. Demonstration using Physical Models / Systems	00	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		**60**

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 (60% Weightage)	

Subcomponent ▸	SC1	SC2	SC3	Component 2: SEE (40% Weightage)
Subcomponent Type ▸	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▸	20	20	20	
CO-1				
CO-2				
CO-3				
CO-4				
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

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:

Reference Books:

Supply Chain Management by Pearson, "Chopra, Sunil, Peter Meindl, and Dharam Vir Kalra" Pearson Education; Seventh edition.
https://books.google.co.in/books/about/Supply_Chain_Management_by_Pearson.html?id=_CO-DwAAQBAJ&redir_esc=y

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.

10. Course Organization:

Course Code	DSE601A	
Course Title	Supply chain Management and Analytics	
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 specification: Applied Analytics in Health Care

Course Title	Data Analytics in Health Care	
Course Code	DSE602A	
Course Type	Elective	
Department	Data Sciences and Analytics	

Faculty	School of Social Sciences

1. Course Summary:

The course aims to develop a systematic understanding of knowledge and frameworks in the healthcare domain and build analytical skills to address challenges and issues arising from heterogeneous data at volume and scale in health, turning them into insights for improved efficiency in healthcare.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
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

3. Course Outcomes (COs)

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

CO1: Obtain knowledge of the healthcare system, the value chain and sources of health data

CO2: Learn the governance structures and frameworks used when working with health data

CO3: Analyze the dynamics of the economic behaviour of stakeholders and its impact on the quality and structure of public health.

CO4: Apply data science techniques to leverage insights from health data.

4. Course Contents

Unit 1: Introduction to Healthcare Industry

Overview of the Healthcare industry, the difference between Healthcare and Pharma sectors, Healthcare system across by country, Sub-sectors, Business model, Competitive landscape, Current trends and challenges, Common research questions in healthcare

Unit 2: Clinical Data Sources

Data sources in the healthcare industry – primary and secondary, Electronic Medical Records, Electronic Health Records, Challenges associated with data collection, processing and sharing, Public health datasets- Global datasets-ACS, NHIS, HCUP-NIS, BRFSS, WHO; Micro datasets - NSSO, NFHS, IHDS, LASI, and Macro dataset – National Health Accounts, Statista, Ethics and privacy in health data, Analytics in Healthcare - Use cases

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru – 560 054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Unit 3: Regulators in Healthcare & Health Economics
Major regulatory bodies in the industry- Global and Indian setting, Instruments of regulation, Overview of Healthcare Policies, Market Research Associations, Digital marketing in healthcare industry
Introduction to Health Economics, Production and Allocative efficiency of resources, Financing and Insurance in Healthcare, Public Health and Policies.

Unit 4: Machine learning for Healthcare
Data Visualization, Predictive Analytics – Use cases with Regression, Classification, Clustering, Time-series algorithms in disease prediction, outcome prediction, patient segmentation, Hands-on practical

Unit 5: AI Applications in Healthcare
Scope of AI in clinical practice, diagnostics, operations, public health; Integrating AI into clinical workflows, Best practices of AI applications to promote fair and equitable healthcare solutions, Challenges of regulation of AI applications, Categories of AI application – Case Studies

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	2	2	2	2	2	2	2			
CO-2	3	2	2	2	2	2	2	2	2			
CO-3	3	2	2	2	2	2	2	2	2			
CO-4	3	2	2	2	2	2	2	2	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		10
Demonstrations		

1. Demonstration using Videos	05	05
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	30	
Numeracy		05
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	10	
2. Computer Laboratory	00	
3. Lab	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		15
1. Case Study Presentation	10	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	04	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
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 M.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 etc.), COs are assessed as illustrated in the following Table.

				Focus of COs on each Component or Subcomponent of Evaluation		
		Component 1: CE (60% Weightage)				**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	**SC4**	**SC5**	

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Subcomponent Type ▸	Term Test 1	Term Test 2	Seminar	Assignment 1	Assignment 2			40 Marks
Maximum Marks ▸ weightage	15	15	10	10	10			
CO-1	5			10				10
CO-2	10			10				10
CO-3		10			10			15
CO-4		5	10		10			15

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

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

9. Course Resources

Select Readings:

- Celi, L. A., Majumder, M. S., Ordóñez, P., Osorio, J. S., Paik, K. E., & Somai, M. (2020). Leveraging data science for global health, Springer Nature.
- Ewen Harrison & Riinu Pius (2021). R for Health Data Science, Chapman & Hall, CRC Press. R for Health Data Science (ed.ac.uk)

Supplementary References:

- Reddy, C. K., Aggarwal, C. C., Reddy, C. K., & Aggarwal, C. C. (2015). An Introduction to Healthcare Data Analytics, Chapman & Hall, CRC Press.
- Kubben, P., Dumontier, M., & Dekker, A. (2019). Fundamentals of clinical data science, Springer.
- Santerre, R. E., & Neun, S. P. (2012). Health economics -Theories, Insights, and Industry Studies, 5th edition, South-Western Cengage Learning.
- Peng, R. (2019). R Programming for Data Science, Retrieved from: https://bookdown.org/rdpeng/rprogdatascience/
- Grolemund, G & Wickham, H. (2017). R for Data Science, Retrieved from: http://r4ds.had.co.nz/
- Peng, R. (2020). Exploratory Data Analysis with R, Retrieved from: https://bookdown.org/rdpeng/exdata/
- Baumer, B.S., Kaplan, D.T., & Horton N.J. (2023). Modern Data Science with R, Retrieved from: https://mdsr-book.github.io/mdsr3e/

10.Course Organization:

Course Code	DSE602A		
Course Title	Applied Analytics in Health Care		
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: Data Story Telling

Course Title	Data Story Telling	
Course Code	DSC603A	
Course Type	Practical	

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The Business Intelligence using Power BI course is designed to equip learners with the skills needed to analyze and visualize data effectively. Starting with an introduction to Power BI, participants will learn to connect to various data sources and perform data transformations using Power Query. The course progresses to developing interactive dashboards and reports, leveraging advanced DAX functions and custom visuals. Learners will explore industry-specific applications in finance, healthcare, and education, creating dashboards that address real-world challenges. Additionally, the course covers integration with platforms like Python and Power Automate for workflow automation and real-time data solutions. Throughout the course, case studies and hands-on projects will reinforce learning and practical application. By the end, learners will be confident in building sophisticated dashboards and enhancing their problem-solving skills in data analytics. This course is ideal for anyone looking to become proficient in Power BI and improve their data-driven decision-making capabilities.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
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: Master Data Connectivity and Transformation

Learners will gain the ability to connect Power BI to various data sources, such as Excel and databases. They will learn how to transform raw data into clean, structured datasets using Power Query and apply effective data modeling techniques.

CO-2: Develop Advanced Dashboards and Reports

Learners will be able to create interactive and visually appealing dashboards and reports. They

will utilize advanced DAX functions and custom visuals to present key business insights clearly and effectively.

CO-3: Apply Power BI in Industry-Specific Scenarios

Learners will learn how to apply their Power BI skills to specific industries like finance, healthcare, and education. They will build dashboards that analyze important metrics, aiding in decision-making and addressing real-world challenges.

CO-4: Integrate and Automate Power BI Solutions

Learners will understand how to integrate Power BI with other platforms, such as Python and Power Automate. They will be able to automate workflows and create real-time data solutions, leveraging advanced features of Power BI for enhanced analytics.

4. Course Contents

Module 1: Introduction to Power BI and Data Visualization Basics

This module will introduce learners to Power BI, its interface, and basic data visualization concepts.

Topics:

Introduction to Business Intelligence (BI) and Data Analytics, Overview of Power BI and its components (Desktop, Service, Mobile), Power BI Interface: Navigation, Workspace, and Data Pane, Connecting to Data Sources (Excel, CSV, Databases, Cloud sources), Basic Data Transformations using Power Query, Introduction to Data Modeling, Building basic reports and visualizations (Bar charts, Pie charts, Maps, etc.), Introduction to DAX (Data Analysis Expressions)

Case Study & Project:

Project: Build a Sales Overview Dashboard using retail sales data, applying basic charts, and visual elements to analyze key performance indicators (KPIs) such as sales trends, profit margins, and regional performance.

Module 2: Intermediate Data Modeling and Transformation

This module will dive deeper into data modeling, relationships, and transforming data for complex visualizations.

Topics:

Advanced Data Transformation using Power Query, Data Modeling Best Practices (Relationships, Hierarchies), DAX Functions for Advanced Calculations (SUM, AVERAGE, IF, FILTER), Time Intelligence Functions in DAX (YTD, MTD, LYTD), Building Calculated Columns and Measures, Data Aggregation, Summarization, and Grouping, Creating Drill-down Reports and Interactive Dashboards

Case Study & Project:
Project: Build a Financial Analytics Dashboard using financial data, focusing on KPIs like revenue growth, cost analysis, and profitability ratios over time.

Module 3: Advanced Data Analytics and Custom Visuals

This module introduces advanced analytics and custom visuals, helping learners gain insights from complex data.

Topics:
Advanced DAX Functions (CALCULATE, ALL, RELATED, SWITCH), Implementing What-If Analysis, Advanced Filtering and Segmentation, Incorporating External Data Sources (APIs, Azure, SharePoint), Creating Custom Visualizations using Power BI Marketplace, Designing Interactive Dashboards with Buttons, Bookmarks, and Tooltips, Enhancing User Experience: Conditional Formatting, Themes, and Layouts, Data Storytelling with Power BI: Narrating insights effectively

Case Study & Project:
Project: Build a Population Data Dashboard analyzing demographic trends, population density, and growth rates across regions, with advanced filtering for insights on age groups, employment, and migration trends.

Module 4: Power BI for Business and Industry-Specific Applications

This module will focus on industry-specific use cases such as finance, healthcare, education, and HR, enabling learners to apply Power BI in diverse domains.

Topics:
Importance of understanding domain knowledge as a part of solving the problem, Power BI in Finance: Financial Statements, Forecasting, Budgeting, Power BI for HR Analytics: Employee Performance, Attrition, and Recruitment, Power BI in Healthcare: Patient Monitoring, Hospital Performance, Power BI in Education: Student Progress Tracking and Reporting, Custom Visuals and Embedding Power BI Dashboards in Applications, Data Security and Governance in Power BI (Roles, Permissions, Row-level Security), Collaboration with Power BI Service: Workspaces, Apps, and Sharing Reports

Case Study & Project:
Project: Build a Student Monitoring Dashboard to track academic performance, attendance, and student engagement metrics. The dashboard will be interactive, allowing filtering by departments, subjects, and cohorts.

Module 5: Advanced Techniques and Power BI Integration

This module will cover advanced Power BI features and integrations with other platforms to build scalable and automated solutions.

Topics:
Power BI and Python/R for Advanced Data Analytics and Visualizations, Power Automate and Power BI Integration for Workflow Automation, Power BI Embedded for Web and Mobile Applications, Real-time Data Streaming in Power BI, Building Paginated Reports with Power BI Report Builder, Performance Optimization in Power BI Reports and DAX Queries, Best Practices for Publishing, Maintaining, and Updating Dashboards, Preparing for Power BI Certifications

Case Study & Project:
Project: Build a Real-time Dashboard for inventory and supply chain management, incorporating live data streams from IoT devices, enabling users to monitor stock levels, supply chain efficiency, and logistics operations in real time.

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	1	1	2	1	2	1	2	2	3	2	1
CO-2	2	2	3	2	2	3	1	2	3	3	2	1
CO-3	3	3	2	3	3	2	2	3	3	3	2	1
CO-4	3	2	2	3	3	2	1	3	3	3	2	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		60
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 Hospital Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		**60**

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 (60% Weightage)			**Component 2: SEE (40% Weightage)**
Subcomponent ▸	**SC1**	**SC2**	**SC3**	
Subcomponent Type ▸	**Midterm exam**	**Assignment -1**	**Assignment-2**	**40 Marks**
Maximum Marks ▸	**20**	**20**	**20**	
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.

8. 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

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

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

Associate Professor
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

10. Course Organization

Course Code	DSL502A		
Course Title	Data Story Telling		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			

SEMESTER 4

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Approved by the Academic Council at meeting held on March 2024

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

Course specification: Research Project

Course Title	**Research Project**
Course Code	DSP601A
Course Type	Core course
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.

2. Course Size and Credits:

Number of Credits	20
Credit Structure (Lecture: Tutorial: Practical)	
Total Hours of Interaction	600
Number of Weeks in a Semester	15
Department Responsible	Data Science 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: Students will be able to employ suitable research methodologies to collect data in a well-informed manner.

CO-4 Critical Data Analysis: 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 the student B.Sc. (Honors) Data Science and Analytics Program. Its primary purpose is to convey the essence and results of the student research endeavor. Should successfully complete the course, the student have the option to have it formally bound and presented as a physical document.

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

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

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

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

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

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

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

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

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

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

Plagiarism: A plagiarism report is used to check originality of a project by highlighting copied content.
It helps ensure academic integrity and guides corrections before final submission.

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

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		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	02	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00

Approved by the Academic Council at meeting held on March 2024

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

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 ▸	**SC 1**	**SC 2**	**SC 3**	**SC 4**	
Subcomponent Type ▸	**CE 1**	**CE 2**	**Project presentation**	**Project Report**	**400 Marks**
Maximum Marks ▸	**50**	**50**	**150**	**150**	
CO					
	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 thebeginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. 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

- Neuman, W.L. (2006). Social Research Methods: Qualitative and Quantitative Approaches (6th Ed.) Boston: Pearson Education.
- Sekaran, U., & Bougie, R. (2013). Research Methods for Business: A Skill-Building Approach (Seventh). John Wiley & Sons Ltd.
- Skiena, S. S. (2017). *The data science design manual*. Springer.
- Hair Jr, J., Page, M., & Brunsveld, N. (2019). *Essentials of business research methods*. Routledge.

10. Course Organization

Course Code	DSP602A	
Course Title	Research Project	
Course Leader's Name	As per the Time Table	
Course Leader's Contact Details	**Phone:**	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore

Approved by the Academic Council at meeting held on March 2024