RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S Ramaiah University of Applied Sciences

Program Structure and Course Details

of

M.Tech (Data Science and Engineering)

Degree Programme

Program Code: 115

Batch: 2019 Onwards

Department of Computer Science and Engineering

Faculty of Engineering and Technology

M S Ramaiah University of Applied Sciences

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S Ramaiah University of Applied Sciences

Programme Specifications

M.Tech. (Data Science and Engineering) Degree Programme

Programme Code: 115

Batch 2019 Onwards

Faculty of Engineering and Technology

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Approved by the Academic Council at its 20th meeting held on 24th July 2019

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

Registrar
M.S.Ramaiah University of Applied Sciences
Bangalore-560054

Dean

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Programme Specifications: M. Tech. (Data Science and Engineering)

Faculty	Engineering and Technology
Department	Computer Science and Engineering
Programme Code	115
Programme Name	M.Tech. (Data Science and Engineering)
Dean of the Faculty	Dr. Dilip Kumar Mahanty
Head of the Department	Dr. T P Pushphavathi

1. **Title of the Award:** M.Tech. (Data Science and Engineering)
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:** Faculty of Engineering and Technology, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** July 2022
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 04 July 2022
8. **Next Review Date:** June 2026
9. **Programme Approving Regulating Body and Date of Approval:**
10. **Programme Accredited Body and Date of Accreditation:**
11. **Grade Awarded by the Accreditation Body:**
12. **Programme Accreditation Validity:**
13. **Programme Benchmark:**
14. **Rationale for the Programme**

The ability to understand data and gain insights has become extremely critical to success in innovation and businesses in various domains. While Data Science and Engineering, as a field, is still evolving, the demand for professionals and researchers in the area is increasing day by day. It is quite well known that currently industry and R&D establishments have a very high recruitment need for professionals in Data Science while the production of qualified personnel is rather low.

With the advent of Big Data in all spheres of human activity, Data Science and Engineering as a programme needs to enable students to gain a deep knowledge of various phases of Big Data life cycle, starting from data pre-processing, curation to effective data mining algorithms and finally to efficient architectures based on the map-reduce paradigm for deployment of such applications. Knowledge discovery from huge volumes of data can be a significant differentiating factor in

Registrar (Academics)
M.S.Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

achieving success in research activities and also for decision making in various businesses. A quick glance at the status of production of data science and engineering professionals with comprehensive knowledge and insights, to meet the demands of niche jobs in the industry and R&D labs and academia, reveals that there is a strong need for MTech programmes of high quality covering relevant breadth and depth requirements in data science and engineering. There is an urgent need for high-quality Data Science professionals to address the design and implementation requirements of various phases of Big Data Life Cycle in various application domains such as Healthcare, Genomics and Cyber Security. Thus there is a strong need for a programme that allows a student to delve into theory and practice of Data Science and Engineering, enabling him or her to innovate in the process of solving data mining problems for various applications and efficiently deploying Big Data applications employing appropriate distributed computing paradigms.

15. Programme Mission

The aim of the programme is to enable postgraduates with advanced knowledge and understanding of Data Science and Engineering; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of industries related to data science and engineering; Big data applications, academics, research or take up an entrepreneurial role.

16. Gradate Attributes (GAs)

GA-1. Engineering knowledge: Ability to apply knowledge of mathematics, science, and Engineering fundamentals to solve complex problems in engineering

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

GA-3. Design and Development of Solutions: Ability to design an engineering 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 engineering 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 engineering activities

GA-6. The Engineer and Society: Ability to understand the effect of engineering solutions on legal, cultural, social, and public health and safety aspects

GA-7. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-8. Ethics: Ability to apply ethical principles to engineering practices and professional responsibilities

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

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

GA-9. **Individual and Teamwork:** Ability to work as a member of a team, to plan and to integrate knowledge of various engineering disciplines and to lead teams in multidisciplinary settings

GA-10. **Communication:** Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-11. **Project Management and Finance:** Ability to lead and manage multidisciplinary teams by applying engineering and management principles

GA-12. **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.Tech. graduates will be able to:

PO-1. Acquire, comprehensive knowledge and understanding of the methodologies, principles, practices, and technologies of the engineering domain to solve complex problems with technical competence

PO-2. Conceptualize, apply, analyze, synthesize, and evaluate information related to complex engineering problems using principles of mathematics, science, and engineeringto create new and innovative solutions

PO-3. Provide solutions to engineering problems by designing systems, components, or processes to meet the specified needs considering public health, safety, societal and the environmental considerations

PO-4. Review research literature, standards, guidelines, best practices, research methods and laboratory techniques to solve engineering problems through experimental investigations, analysis, and interpretation of results

PO-5. Create, select, and apply appropriate techniques and IT tools to model and solve complex engineering activities and utilize available resources effectively

PO-6. Understand the effect of engineering solutions on legal, cultural, social, public health and safety aspects and the consequent responsibilities

PO-7. Develop sustainable engineering solutions and assess their effect on society and Environment

PO-8. Understand and apply ethical principles to engineering practices and professional Responsibilities

PO-9. Function effectively as an individual or a team player to handle diverse problems in multi-disciplinary settings

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

PO-10. Make oral and written presentations to communicate technical ideas effectively to engineering community and society at large

PO-11. Apply the knowledge of engineering and management principles to manage projects in multi- disciplinary environment with consideration to cost and time.

PO-12. Engage in lifelong learning and adapt to changing engineering/technology and societal requirements

18. Programme Goal

The goal of the programme is to produce postgraduates with advanced knowledge and understanding of data science and engineering systems; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of industries related to data science and engineering systems, academics, research or take up entrepreneurial route.

19. Program Educational Objectives (PEOs)

The objectives of the M.Tech.(Data Science and Engineering) Programme are to:

PEO-1. To provide in-depth knowledge in the specialized engineering domain to enable them to deliver efficient solutions for complex engineering

PEO-2. To enable students to design and develop sustainable innovative solutions for industry and societal requirements through applied research by conducting engineering investigations through experimentation with usage of modern tools

PEO-3. To inculcate ethics, communication, leadership, soft, managerial and entrepreneurial skills for a successful career in industries and to engage in lifelong learning

20. Programme Specific Outcomes (PSOs)

At the end of the M.Tech.(Data Science and Engineering) program, the graduate will be able to:

PSO-1. Apply principles of Data Science at large and in particular that of Big Data to real-life problems employing critical analysis

PSO-2. Design and develop sustainable and Big Data solutions to address industrial and societal requirements of insightful knowledge extraction by applying concepts and techniques of Data Mining, Data Processing, Distributed and Cloud Computing

PSO-3. Demonstrate leadership qualities, communication, entrepreneurial skills, decision making based on ethics and passion for lifelong learning for improvement of organization, environment and society

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

21. Programme Structure:

SEMESTER 1							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MIC501A	Mathematics for Machine Learning	3	2		4	100
2	19DSC501A	Programming for Data Science	3		2	4	100
3	19DSC502A	Data Mining	3	2		4	100
4	19MIC502A	Professional Elective - 1	3		2	4	100
5	19DSC503A	Data Processing	3		2	4	100
6	19FET509A	Research Methodology & IPR	2	--	--	2	50
7	19FET510A	Professional Communication	1	--	--	0	0
Total			18	4	6	22	550
Total no. of Hours per Week			24				

SEMESTER 2							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MIC504A	Artificial Neural Networks	3	2	2	5	100
2	19DSC505A	Advanced Data Processing	3	2	2	5	100
4	19DSE502A	Professional Elective - 2	3	2		4	100
5	19DSE503A	Professional Elective - 3	3	2		4	100
6	19DSE504A	Professional Elective 4	3	2		4	100
7	19FET520A	Value Education	1			0	
Total			16	10	4	22	500
Total no. of Hours per Week			25 Hours				

SEMESTER 3							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MIC521A	Internship			10	4	100
2	19MIC522A	Group project			15	8	200
Total			-	--	25	12	300
Total number of contact hours per week			25 hours				

SEMESTER 4							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19MIC523A	Dissertation and Publication	--	--	24	24	400
Total					24	24	400
Total number of contact hours per week			24 hours				

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Note: Students are required to select Professional Elective course in the 1st Semester and 2nd Semester, from Elective list given as follows:

Elective Courses

Stream /Specialization	S.No.	Course Code	Course Title
Natural Language Processing	1	19MIC502A	Artificial Intelligence
	2	19DSE502A	Distributed Computing
	3	19DSE503A	Natural Language Processing
	4	19DSE504A	Text Mining and Visualization
	5	20DSE507A	Time Series Analysis
BigData Applications	1	19MIC502A	Artificial Intelligence
	2	19DSE502A	Distributed Computing
	3	19DSE506A	Big Data & Software Defined Networks
	4	19DSE505A	Big Data & Healthcare

22. Elective Courses

There are 4 electives in the programme. The electives are grouped such a way that a student can choose a set of electives to specialize in a chosen field/stream. However, if the student wishes to opt for elective module that spans multiple streams, the case may be considered subject to the affordability of academic logistics and approval by the module leader, HODs and Deans.

For every elective offered, there will be a minimum and a maximum number of registrations that is decided by the department.

There is also a provision for the students to choose PE3 and PE4 through on-line mode such as MOOC's, SWAYAM, NPTEL and other equivalent platforms. The guidelines prescribed by the University for such courses to be adhered to. The student can also earn 3 or 4 credits by participating in the international competitions like technical presentation/ conference/ publications in the journal etc and winning the award in that. In that case he/she can be exempted from one of the elective courses of the programme.

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

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project
11. Exhibitions
12. Technical Festivals

25. Assessment and Grading

25.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have equal weightage (CE: 50% and SEE: 50%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

25.2. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

25.2.1 Theory Courses

The following **TWO options** are available for each Faculty to perform the CE exercise.

Option 1 for a Theory Course:

Theory Course			
SC1	SC2	SC3	SC4
25 Marks	25 Marks	25 Marks	25 Marks

In Option 1, there shall be four subcomponents of CE (SC1, SC2, SC3 and SC4). Each subcomponent is evaluated individually for 25 marks. It is mandatory that two of the

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

four subcomponents are term-tests. The remaining two subcomponents can be of any of the following types:

a) Online Test
b) Assignments/Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

After the four subcomponents are evaluated, the CE component marks are determined as:

CE Component Marks = (Total of the marks obtained in all the four subcomponents) ÷ 2

An additional subcomponent (SC5) may be used at the discretion of the Faculty/Department. The department can conduct the 5th subcomponent SC5 if this subcomponent gives benefit to students. If the Department/Faculty conducts the SC5 subcomponent of evaluation, and the score obtained by the student in SC5 is greater than the lowest score of the previous four subcomponents SC1 to SC4, then it replaces the lowest of the four scores.

Option 2 for a Theory Course:

Theory Course			
SC1	SC2	SC3	SC4
25 Marks	25 Marks	25 Marks	25 Marks

In Option 2, there shall be four subcomponents, each carrying 25 marks. Out of these, there shall be two assignments and two term-tests. The assignments can be of any of the following types:

a) Online Test
b) Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

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

Registrar
M.S.Ramaiah University of Applied Sciences
Bangalore-560054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

After the four subcomponents of CE are evaluated, the CE component Marks are determined as:

CE Component Marks = (Best of two Assignment Marks) + (Best of two Term-Test Marks)

Each Faculty Dean, in consultation with the heads of all departments in the Faculty and the Faculty Academic Registrar, decides whether Option 1 or Option 2 is adopted for each programme offered by the Faculty. He/she notifies the students about the option at the beginning of the semester.

25.2.2 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

Laboratory Course		
SC1	SC2	SC3 (Optional)
25 Marks	25 Marks	25 Marks

The subcomponents can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

After the subcomponents of CE are evaluated, the CE component Marks are determined as:

CE Component Marks = (Total of the best two subcomponent marks out of the three) ÷ 2

25.2.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

For a Course having a Combination of Theory and Laboratory Sessions			
SC1 (Theory)	SC2 (Theory)	SC3 (Theory)	SC4 (Laboratory)
25 Marks	25 Marks	25 Marks	25 Marks

There shall be four subcomponents, each carrying 25 marks. Out of these, there shall be two term-tests and an assignment to evaluate the students' performance in theory. The fourth subcomponent shall be set to evaluate the students' performance in the laboratory.

The theory assignment can be of any of the following types:

a) Online Test
b) Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

The laboratory subcomponent can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

After the four subcomponents are evaluated, the CE component marks are determined as:

CE Component Marks = (Total of the marks obtained in all the four subcomponents) ÷ 2

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

26. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

27. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

28. 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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	Mathematics for Machine Learning	3	2	3	2	3	3	2	3	1	1	1	1	3	3	2
1	Programming for Data Science	3	2	3	2	2	3	2	3	1	1	1	1	3	3	2
1	Data Mining	3	2	3	2	3	3	2	3	1	1	1	1	3	3	2
1	Professional Elective - 1	3	3	3	2	3	3	2	3	1	1	1	1	3	3	
1	Data Processing	3	3	3	2	3	3	2	3	2	1	1	2	3	3	2
1	Research Methodology and IPR				3		3	3	3	2	3	2	2		3	3
1	Professional Communication					2					3					
2	Artificial Neural Networks	3	3	3	2	3	3	2	3	1	1	1	2	3	3	2
2	Advanced Data Processing	3	3	3	1	2	3	2	3	2	2	3	2	3	3	2
2	Professional Elective – 2	1	2	3	3	3	3	3	2	2	2	3	2	3	3	2
2	Professional Elective – 3	3	3	3	1	1	1	1	1	1	1	1	1	3	3	1
2	Professional Elective - 4	3	3	3	2	2	1	1	1	1	1	1	1	3	3	1
2	Value Education							2	3	2			3			
3	Internship	3	3	3	2	3	2	1	2	3	3	1	3	3	3	3
3	Group project	3	3	3	2	2				1	1			3		
4	Dissertation and Publication	3	3	3	2	2				1	1			3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

29. 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.

30. 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.

31. 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.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Course Specifications

M.Tech. (Data Science and Engineering) Degree Programme

Programme Code: 115

Faculty of Engineering and Technology

Batch 2019 Onwards

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Course Specifications: Mathematics for Machine Learning

Course Title	Mathematics for Machine Learning
Course Code	19MIC501A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Students shall be taught mathematical concepts and techniques that are a pre-requisite for machine learning and data science. A number of topics such as linear algebra, matrix decompositions, vector calculus, probability and statistics and continuous optimization are covered.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** To discuss geometric terms such as planes in higher dimensions and perform mathematical operations on them.
- **CO-2.** To apply different methods to analyse patterns in data and use them to predict, understand, and improve results.
- **CO-3.** To design techniques for reducing the number of variables in training data when dealing with high dimensional data.
- **CO-4.** To discuss the methods for accurate data representation in a lower-dimensional space.
- **CO-5.** To apply the techniques for predicting continuous and discrete values.
- **CO-6.** To develop methods for finding optimal parameter configuration for high dimensional functions.

4. Course Contents

Unit 1 (Linear Algebra): Introduction to Linear Algebra, Introduction to Vectors, Row Vector and Column Vector, Dot Product and Angle between two Vectors, Projection and Unit Vector, Line, Hyperplane, Circle, Ellipse, Hyper Cube

Unit 2 (Probability and Statistics): Introduction to Probability and Statistics, Population and Sample, Gaussian/Normal Distribution, Symmetric distribution, Standard normal distribution, Kernel density estimation, Sampling, Q–Q plot, Chebyshev's inequality, Uniform distributions, Discrete distributions,

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Continuous distributions, Power law distribution, Power Transformation, Non-gaussian distributions, Covariance, Correlation, Measuring correlation, Applying correlations, Confidence interval, Hypothesis testing, Kolmogorov–Smirnov test, Proportional Sampling

Unit 3 (Dimensionality reduction): Introduction to Dimensionality reduction, Data set representation, Matrix representation of data set, Data Preprocessing, Feature Normalization, Mean, Column Standardization, Covariance of a Data Matrix

Unit 4 (Principal component analysis (PCA)): Introduction to PCA, Geometric intuition, Mathematical objective function, Distance minimization, Eigen values and Eigen vectors, Dimensionality reduction, PCA Limitations

Unit 5 (Classification And Regression): Introduction to Classification and Regression, Data matrix notation, K-Nearest Neighbours (K-NN), Distance measures, Cosine Distance & Cosine Similarity, Measuring K-NN, Time and space complexity, Decision surface, Overfitting and Underfitting, K-fold cross validation, Time based splitting, K-NN for regression, Weighted k-NN, Building a kd-tree, Find nearest neighbours using kd-tree, Locality Sensitive Hashing, Cosine similarity, Euclidean distance, Probabilistic class label

Unit 6 (Optimization problems): Differentiation, Maxima and Minima, Vector calculus, Gradient descent, Learning rate, Stochastic gradient descent, Constrained Optimization

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	2	1			2								3	3		
CO-2	3	2											3	3	2	
CO-3	2					3		3		1			3	3		
CO-4	1	2				3	2					1	3	3		
CO-5	3		3	2					1		1		3	3		
CO-6					3			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		30
Demonstrations		03
1.Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer	02	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		10
1. Course Laboratory	00	
2. Computer Laboratory	10	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	02
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	01	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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.Tech. (Artificial Intelligence and Machine Learning) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Assignment	Term Test	Assignment	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	X
The details of SC1, SC2, SC3 or SC4 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, Assignments

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

9. Course Resources

a. Essential Reading

1. Marc Peter Deisenroth, A.Aldo Faisal, Cheng Sooon Ong (2019). Mathematics for Machine Learning, Published by Cambridge University Press.
2. Class Notes.

b. Recommended Reading

1. José Unpingco (2016). Python for Probability, Statistics, and Machine Learning, Published by Springer.
2. Chris Albon (2018). Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning, Published by O'Reilly.

c. Magazines and Journals

1. Journal of Machine Learning Research, The MIT Press
2. Machine Learning, Springer
3. IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE
4. International Journal of Machine Learning and Cybernetics, Springer
5. IEEE Transactions on Neural Networks and Learning Systems, IEEE
6. Information Sciences, Elsevier

d. Websites

1. https://machinelearningmastery.com/
2. https://www.kdnuggets.com/
3. https://towardsdatascience.com/
4. https://medium.com/analytics-vidhya
5. https://www.geeksforgeeks.org/machine-learning/

10. Course Organization

Course Code	19MIC501A	
Course Title	Mathematics for Machine Learning	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Course Specifications: Programming for Data Science

Course Title	Programming for Data Science
Course Code	19DSC501A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Students shall be taught programming concepts and techniques mainly using Python and the concepts are a pre-requisite for machine learning and data science. A number of topics such as data visualization and program development for machine learning and data science from scratch shall be explored in addition to directly using relevant libraries.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** To discuss basic Python programming concepts and execution.
- **CO-2.** To develop different ways of organizing data and working with functions.
- **CO-3.** To apply different libraries for multidimensional array objects, data visualization, data manipulation, and data analysis.
- **CO-4.** To apply relational database concepts and foundational knowledge for communicating with and extracting data from databases.
- **CO-5.** To identify obvious errors and understanding patterns within the data, detect outliers, and find interesting relations among the variables.

4. Course Contents

Unit 1 (Programming Fundamentals): Introduction to Programming language, Keywords and identifiers, Comments, Indentation and statements, Variables and data types, Standard Input and Output, Operators, Control flow

Unit 2 (Data Structures and Functions): Lists, Tuples, Sets, Dictionary, Strings, Introduction to functions, Types of functions, Function arguments, Recursive functions, Lambda functions, Modules, Packages, File Handling, Exception Handling, Debugging, Time and Space Complexity

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

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

Unit 3 (Basic Data Processing and Visualization): Introduction to Numpy, Scientific computing with Numpy, Data visualization with Matplotlib, Data manipulation and analysis with pandas, Basics of Data Frame, Basic Operations on Data Frames

Unit 4 (Programming with Databases): Introduction to SQL, Applying SQL to huge datasets, Data selection, Data Grouping, Ordering results, Data extraction, Organizing SQL Queries, Combining data sources

Unit 5 (Exploratory Data Analysis): Introduction to dataset, Scatter plot, Pair plots, Probability Density Function, Cumulative Distribution Function, Mean, Variance and Standard Deviation, Median, Percentiles and Quantiles, Inter Quartile Range and Median Absolute Deviation, Plotting data, Univariate, Bivariate and Multivariate analysis, Multivariate Probability Density, Representing a 3-dimensional surface

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	2	1			2								3	3		
CO-2	1	2											3	3		
CO-3	3					3		3		1			3	3	2	
CO-4	3	2				3	2					1	3	3	2	
CO-5			3	2					1		1		3	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		30
Demonstrations		03
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		25
1. Course Laboratory	00	
2. Computer Laboratory	25	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

Others		02
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	01	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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.Tech. (Artificial Intelligence and Machine Learning) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Assignment	Term Test	Assignment	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
The details of SC1, SC2, SC3 or SC4 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, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Assignments
4.	Analytical Skills	Assignments
5.	Problem Solving Skills	Assignments, Examination
6.	Practical Skills	Assignments
7.	Group Work	--
8.	Self-Learning	Self-study

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

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

9. Course Resources

e. Essential Reading

1. Jake VanderPlas (2016), Python Data Science Handbook, O'Reilly.
2. Class Notes.

f. Recommended Reading

1. Wes McKinney (2017), Python for Data Analysis, O'Reilly
2. Al Sweigart (2015), Automate The Boring Stuff With Python
3. Andreas C. Müller & Sarah Guido (2016), Introduction to Machine Learning with Python

g. Magazines and Journals

1. International Journal of Data Science and Analytics, Springer
2. Data Mining and Knowledge Discovery, Springer
3. IEEE Transactions on Knowledge and Data Engineering, IEEE
4. Artificial Intelligence, Elsevier
5. Journal of Big Data, Springer

h. Websites

1. https://machinelearningmastery.com/
2. https://elitedatascience.com/
3. https://www.kdnuggets.com/
4. https://www.kaggle.com/
5. https://online.datasciencedojo.com/blog/
6. https://ryanswanstrom.com/blog/
7. https://towardsdatascience.com/

10. Course Organization

Course Code	19DSC501A	
Course Title	Programming for Data Science	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specifications: Data Mining

Course Title	Data Mining
Course Code	19DSC502A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

The course aims to teach a broad overview of data science in different areas from statistics, machine learning to data engineering. The course aids students to understand and apply the fundamental concepts essential in data science from data acquisition to insight and impacts of data. The course trains students in data analysis, decision making and is designed to equip them with the ability to derive insights from vast quantities and varieties of data. The emergence of massive datasets containing a lot of observations provides the primary impetus for the field. Students shall be taught to understand the principles, methods and technologies used in data science and data science approach is being used to develop decision making process in various applications.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** To be able to understand the fundamental concepts essential in data science, from data acquisition to insight and social impacts of big data.
- **CO-2.** To design data analytics applications using machine learning and data mining techniques for knowledge discovery
- **CO-3.** To develop algorithms, statistical approaches and visualization techniques for explorations of large scale data.
- **CO-4.** To develop prototypes for new data analytics applications.
- **CO-5.** To analyse the data as well as the performance of the data analytics applications
- **CO-6.** To apply appropriate methodologies to selected applications in data science.

4. Course Contents

Unit 1 Introduction:
Introduction to data science and Big Data, Importance of data science, The Current trends, Data Science Jobs, Applications. Introduction to Data mining, knowledge discovery process, data mining issues. Data Analytics and its role in Business Intelligence and Knowledge Discovery. Data Analytics processes:

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

Dean

Dean - Academics

Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

M.S. Ramaiah University of Applied Sciences, Bangalore-560054

reparation, Warehousing, Analysis, Mining, Validation and Performance Evaluation. Data Analytics tools and platforms and applications.

Unit 2 (Understanding data): Data objects and attributes, statistical descriptions of data, data visualization, measuring similarity and dissimilarity, knowledge representation general insights.

Unit 3 (Data warehousing and modelling): Traditional Data Base systems for data storage and processing. Big data and Cloud based platforms such as Hadoop. Data warehousing and analysis: Initial data analysis, Statistical data analysis methods, Multidimensional data modeling, data cube, OLAP

Unit 4 (Machine Learning and Knowledge Discovery): unsupervised learning: clustering and categories of clustering, association rule mining. Supervised learning: statistical methods, Bayesian networks. Decision trees, Artificial Neural Networks

Unit 5 (Data mining): Knowledge generation from Data Mining. Relation and contrast with Machine Learning. Classification and different types of classifiers, Predictive data mining.

Unit 6 (Advances in Data analytics): Traditional analytics and Big data analytics, text analytics, web analytics, multimedia analytics, mobile analytics, social network analytics. Research trends.

Unit 7 (Applications): Business analytics, Science informatics, Web science, Social data informatics, Health and Biomedical informatics.

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	2	1			2											
CO-2	1	2														
CO-3	3					3		3		1			3			
CO-4	3	2				3	2					1		3		
CO-5			3	2					1		1				2	
CO-6					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		40
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		10
1. Solving Numerical Problems	10	
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	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		10
Total Duration in Hours		**70**

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.Tech. (Computer Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Assignment	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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, Assignments
2	Understanding	Classroom lectures, Assignments
3	Critical Skills	Assignments
4	Analytical Skills	Assignments

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

9. Course Resources

i. Essential Reading

1. Class Notes
2. Han, J., Kamber, M., and Pei, J. (2012) *Data Mining: Concepts and Techniques*, 3rd edn. Morgan Kauffman
3. Cios, K. J., Pedrycz, W., Swiniaski, R. W., and Kurgan, L. A. (2007) *Data Mining: A Knowledge Discovery Approach*. Springer

j. Recommended Reading

1. Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer, 2010.
2. Mining of Massive Dataset. Jure Leskovec, Anand Rajaraman, Jeff Ullman.
3. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 2011
4. Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. Springer, 2009.
5. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012.
6. Data Analytics: Concepts, Techniques, and Applications - Mohiuddin Ahmed, Al-Sakib Khan Pathan, CRC Press, Published October 2, 2018

k. Magazines and Journals

1. IEEE Transactions on data and knowledge engineering
2. Data Mining and Knowledge Discovery
3. International Journal of Data Warehousing and Mining

l. Websites

1. https://datascience.berkeley.edu/academics/curriculum/fundamentals-of-data-engineering/
2. https://datascience.berkeley.edu/academics/curriculum/research-design-application-data-analysis/
3. http://cm.dce.harvard.edu/2014/01/14328/publicationListing.shtml
4. http://cds.iisc.ac.in/courses/ds256/
5. http://cds.iisc.ac.in/academics/mtechcds/#CourDesc

10. Course Organization

Course Code	Data Mining	
Course Title	19DSC502A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Course Specifications: Artificial Intelligence

Course Title	Artificial Intelligence
Course Code	19MIC502A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at providing theoretical and hands-on exposure to artificial intelligence, intelligent agents and their applications. The principles of knowledge representation, search strategies, learning, reasoning and planning will be covered in detail. Application of the principles of artificial intelligence in machine learning, robotics and perception will be discussed. There will be a special emphasis on the analysis and synthesis of intelligent agent-based applications of artificial intelligence.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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. Describe the concepts of artificial intelligence and intelligent agents
CO-2. Explain the principles of knowledge representation, search strategies, learning, reasoning and planning
CO-3. Apply the principles of knowledge representation, search strategies, learning, reasoning and planning to design intelligent agents
CO-4. Analyze a scenario and identify strategies for knowledge representation, search, learning, reasoning and planning
CO-5. Synthesize an intelligent agent for a given scenario
CO-6. Evaluate the performance of an intelligent agent based on appropriate measures of performance

4. Course Contents

Unit 1 (Introduction): Overview of AI problems and examples, Intelligent behavior, The Turing test, Rational versus non-rational reasoning, AI problem characteristics, Nature of agents: Autonomous versus semi- autonomous, Reflexive, goal-based, and utility-based. Perception and environmental interactions.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Unit 2 (Search Strategies): Problem spaces-states, goals and operators, problem solving by search, Factored representation, Uninformed search, Heuristics and informed search. Game playing and minimax search, Constraint satisfaction-backtracking and local search methods. Advanced search: Search trees, stochastic search techniques.

Unit 3 (Knowledge Representation and Reasoning): Propositional and Predicate Logics for logical reasoning. Resolution and theorem proving. Forward and backward chaining. Probabilistic reasoning. Rule-based Expert Systems. Fuzzy Logic. Descriptive Logics. Ontology engineering.

Unit 4 (Machine Learning): Introduction, Supervised and Unsupervised learning: Classification, and Clustering. Theory of learning: PAC learning framework. Artificial Neural Networks, Statistical learning, Decision Trees, Over-fitting problem and generalization.

Unit 5 (Agents): Agent architectures. Agent theory-Rationality and Game Theory. Decision-theoretic agents. Software agents: Information gathering and access, Believable and Learning agents. Multi-agent systems: Collaborating agents, Agent teams, Competitive agents, Swarm systems and biologically inspired models.

Unit 6 (Planning): Partial and totally ordered planning, Plan graphs, Hierarchical planning, Planning and execution-conditional planning and continuous planning, Mobile agent/Multi-agent planning.

Unit 7 (Reasoning Under Uncertainty): Conditional Independence, Knowledge representations-Bayesian Networks, Exact inference, Randomised sampling methods, Markov Networks, Hidden Markov Models. Causality

Unit 8 (Decision Theory): Preferences and utility functions, Maximising expected utility.

Unit 9 (Applications): Natural Language Processing, Robotics, Perception and Computer Vision

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	3	3											3			
CO-2	1	3	3										3			
CO-3	3	3	3			3		3		1			3			
CO-4	3	3	3			3	2					1	3			
CO-5	3	3	3	2					1		1		3	3		
CO-6	3	3	3		3			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		30
Demonstrations		03
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

3. Demonstration on a Computer	03	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		02
1. Case Study Presentation	02	
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		10
Total Duration in Hours		**70**

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.Tech. (Computer Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Lab Exam	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	×	×			×
CO-2	×	×			×
CO-3	×	×			×
CO-4			×	×	×
CO-5			×	×	
CO-6			×	×	
The details of SC1, SC2, SC3 or SC4 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.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

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

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

9. Course Resources

a. **Essential Reading**

1. Course notes
2. Russel, S. J., and Norvig, P., 2010, Artificial Intelligence: A Modern Approach, 3rd Edn, Prentice-Hall
3. Amit Konar, 2000, Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain, Taylor & Francis Inc

b. **Recommended Reading**

1. Rich, E., and Knight, K., 2009, Artificial Intelligence, 3rd Edn, Tata McGraw Hill
2. Nilsson, N. J., 1998, Artificial Intelligence: A New Synthesis, , Morgan Kaufmann
3. Neapolitan, R. E., and Jiang, X., 2012, Contemporary Artificial Intelligence, CRC Press
4. Luger, G., and Stubblefield, W., 2004, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Benjamin/Cummings
5. Sowa, J. F., 2000, Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole
6. Shai, S-S., and Shai, B-D., 2014, Understanding Machine Learning, Cambridge University Press
7. Alpaydın, E., 2014, Introduction to Machine Learning, 3rd Edn, The MIT Press
8. Pearl, J., 1986, Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference, Morgan Kaufmann

c. **Magazines and Journals**

1. Journal of Artificial Intelligence Research
2. Journals in Artificial Intelligence
3. Applied Artificial Intelligence
4. IEEE Intelligent Systems

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5. IEEE Access
6. The International Journal of Robotics Research
7. Journal of the ACM

d. Websites

1. https://www.tutorialspoint.com/artificial_intelligence/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/
3. https://web.stanford.edu/class/cs221/#coursework
4. https://www.technologyreview.com/artificial-intelligence/
5. https://www.javatpoint.com/artificial-intelligence-tutorial
6. https://nptel.ac.in/

10. Course Organization

Course Code	19MIC502A	
Course Title	Artificial Intelligence	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specifications: Data Processing

Course Title	Data Processing
Course Code	19DSC503A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course aims to teach methods, techniques and tools for data processing in modern data science applications. The data preparation stage operations of data collection, data munging and wrangling are detailed. Data processing workflow is covered. Data processing using relational databases is reviewed and multidimensional data processing using OLAP is detailed. Data processing for applications employing a wide variety of data models, representations, approaches, frameworks and libraries is covered. Students employ modern tools and platforms to develop data processing pipelines and workflows for applications and scenarios.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** To choose appropriate data processing techniques, frameworks and tools for a structured data
- **CO-2.** To develop models for structured data using relational and data cube schemas
- **CO-3.** To design a data processing application for structured data using structured data processing techniques, frameworks and tools
- **CO-4.** To synthesize a data processing application for structured data
- **CO-5.** To analyze structured data using a data processing workflow
- **CO-6.** To evaluate alternative solutions to a data processing problem

4. Course Contents

Unit 1 (Data Quality): Introduction to data processing, Imprecision, Incompleteness, Noise, Missing Values, Redundancy

Unit 2 (Data Scraping): Data spidering and web crawling, Data scraping, Web data scraping using libraries and tools for data scraping.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560 054

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

Unit 3 (Data Munging and Wrangling): Data Extraction, Data Editing and Cleaning, Data transformation, Data Integration, Data loading, Data updating and refreshing. Libraries and tools for munging and wrangling data.

Unit 4 (Structured data processing): Entity Relationship (ER) modelling and representation. Domain specific ER models/databases: Object Oriented, Object Relational, Transactional, Spatial, Temporal, Textual and Multimedia databases. Designing data processing workflow. Relational Data processing: Populating, querying and processing data from Relational DBMS. Processing using middleware libraries and embedded SQL programming.

Unit 5 (Multidimensional data processing): Multidimensional data, concept hierarchies. Fact Tables,Data warehouses Star, snowflake and galaxy schemas. OLAP Cube data model. Fundamental OLAP data operations: Rollup, Drilldown, Slice and Dice, Pivot. OLAP cube realisations: R-OLAP, M-OLAP, H-OLAP. Lattice of cuboids. Compute Cube operation and its optimization. Process Cube models. OLAP servers and software for OLAP. Defining OLAP Cube schemas, Cube creation and population, Programming MDX querying and data processing using OLAP.

Unit 6 (Demonstrations and case studies): Laboratory and Assignment activity: Data processing scripting and programming.Laboratory and Assignment activity: Design and synthesis of relational and multidimensional data processing applications

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	1	2	2		2								3			
CO-2	2	3											3			
CO-3	3					3		3		1			3			
CO-4	3	2	3			3	2					1	3	3		
CO-5	3	3	2	2	2				2		1		3	3	2	
CO-6	3	3	3		3			2				2	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	10	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00

Registrar
M.S.Ramaiah University of Applied Sciences
Bangalore - 560054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

1. Solving Numerical Problems	00	
Practical Work		20
1. Course Laboratory	20	
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		10
Total Duration in Hours		**70**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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:

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

9. Course Resources

a. Essential Reading

1. Course notes
2. Han, J., Kamber, M., and Pei, J., 2011, Data Mining: Concepts and Techniques, 3rd edn., Morgan Kaufmann
3. Data Wrangling with Python by Jacqueline Kazil and Katharine Jarmul, Published by O'Reilly Media, Inc., 1005 Gravenste in Highway North, Sebastopol, CA 95472.
4. Web Scraping with Python, 2nd Edition by Ryan Mitchell, Released April 2018 Publisher(s): O'Reilly Media, Inc. ISBN: 9781491985571

b. Recommended Reading

1. McKinney, W., 2018, Python for Data Analysis, 2nd edn., O'Reilly
2. Best Practices in Data Cleaning by Osborne, Jason W
3. Introduction to Data Mining, 2nd ed., Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Bipin Kumar, published by Pearson, 2019, ISBN 978-0-13-312890-1
4. Getting Started with Python [this link is for the Anaconda Python suite]. A more direct link to Anaconda is https://www.anaconda.com/distribution/
5. A Python reference https://www.programmer-books.com/wp-content/uploads/2019/04/Python-for-Data-Analysis-2nd-Edition.pdf

c. Magazines and Journals

1. https://epjdatascience.springeropen.com/
2. https://www.scimagojr.com/journalsearch.php?q=21100228068&tip=sid&clean=0
3. https://www.inderscience.com/jhome.php?jcode=ijds

d. Websites

1. https://www.youtube.com/playlist?list=PL8eNk_zTBST-gN6Y5E-SFZdARXjglYpyT
2. http://www.cse.msu.edu/~ptan/dmbook/software/
3. https://pandas.pydata.org/docs/user_guide/index.html
4. https://github.com/REMitchell/python-scraping
5. https://www.w3resource.com/python-exercises/pandas/missing-values/index.php

Registrar
M.S.Ramaiah University of Applied Sciences
Bangalore - 560054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

6. https://www.coursera.org/learn/data-patterns#syllabus
7. https://www.coursera.org/learn/python-for-applied-data-science-ai/home/welcome
8. https://www.coursera.org/learn/data-cleaning

10. Course Organization

Course Code	Data Processing		
Course Title	19DSC503A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		**Phone:**	+91-804-906-5555
		E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date		June 2022	
Next Course Specifications Review Date		June 2026	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

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

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

Course Specifications: Research Methodology and IPR

Course Title	Research Methodology and IPR
Course Code	20FET508A
Course Type	Mandatory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the principles of research, research methodology, significant phases of research, Intellectual property, and its rights. Students are taught the realistic guidelines to be followed in the choice of field of research, topic of research and formulation of research problem. Key and careful considerations in the choice of tools for the solution of research problem are covered in this module. The module emphasizes the desirable close-knit relation between innovation and concept of out of the box thinking. The principles of effective research and the need for a Proactive approach in a successful research programme are also explained. The course discusses the significant role of Literature Review in a research cycle and the expectations from good literature review as well as procedure for systematic literature review. This course gives insight of the intellectual property rights and overview of the benefits.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Aerospace Engineering
Total Course Marks	50
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. Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research, Nature of Intellectual Property.

CO-2. Discuss the guidelines to progress from the choice of broad field of research to specific topic of research, patent rights, process of patenting at National and International level, New Developments in IPR.

CO-3. Demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be effective.

CO-4. Adapt, analyze and prepare well-structured research proposal and research paper invoking clearly outlined principles.

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Contents

Unit 1 (Foundations of Research): Definitions of Research, Mandatory Steps in Research, Types of Research, Relevance of Research for Innovation and Technology Development, Effective Research and Self Discipline.

Unit 2 (Formulation of Research Problem): Identification of problems, narrowing down the problem, Factors to be considered for problem selection. History and Evolution of Science & Technology.

Unit 3 (Out of the Box Thinking and Systematic Approach in Research): Transformation to Impossible Thinking, Convergent and Divergent Thinking, Generation, Evaluation and Selection of Ideas, Critical Thinking

Literature Review – Importance of Literature Review, Constituents of Good Literature Review, Strategies for Literature Search, Referencing, Paraphrasing, and Summarizing Academic Standards and Ethics

Research Proposal – Structure of a Good Research Proposal, Getting Started, Tips for Compilation of Good Research Proposal.

Unit 4 (Nature of Intellectual Property): Patents, Designs, Trade and Copyright.
Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: (Patent Rights): Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases, Geographical Indicators.

Unit 6: (New Developments in IPR): Administration of Patent System. New developments in IPR; IPR of Biological Systems, Copy rights for Software. Traditional knowledge 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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1				3		3		3	2	3	2	1	0	3	3
CO-2				3		3		3		1	1	1	0	3	3
CO-3				3		3	3	3		1		1	0	3	3
CO-4				3				2		3	3	1	0	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		20
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		10
1. Case Study Presentation	06	
2. Guest Lecture	04	
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		10
Total Duration in Hours		**40**

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.Tech. (Electronics and Communication Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Assignment	50 Marks
Maximum Marks ▶	25	25	25	25	
CO-1	×	×	×	×	×
CO-2	×	×	×	×	×
CO-3	×	×	×	×	×
CO-4			×	×	
The details of SC1, SC2, SC3 or SC4 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:

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

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

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

1. Course notes
2. Melville, S. and Goddard, W. (1996) Research Methodology: An Introduction for Science & Engineering Students, Juta
3. Merges, R. P., Menell, P. S. and Lemley, M. A. (2016) Intellectual Property in New Technological Age, Fourth Edition, Wolters Kluwer

b. Recommended Reading

1. Kothari, C. R. and Garg G. (2019) Research Methodology: Methods and Techniques, New Age International Publishers

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. NPTEL Videos and Digital Library

10. Course Organization

Course Code	20FET508A	
Course Title	Research Methodology and IPR	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-80-4906-5555
	E-mail:	hod.aae.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

Course Specifications: Professional Communication

Course Title	Professional Communication
Course Code	19FET509A
Program	M.Tech
Course Type	Audit Course
Department	Directorate of Transferable Skills and Leadership Development
Faculty	Engineering and Technology

1. Course Summary

This course aims at sensitising students to the essentials of professional communication. Professional Communication is essential to achieve the objectives of an organisation.

2. Course Size and Credits:

Number of Credits	00
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	10
Number of Weeks in a Semester	16
Department Responsible	Directorate of Transferable Skills and Leadership Development
Total Course Marks	25
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. Compose effective written business communication
CO-2. Practice the techniques of presentation

4. Course Contents

Unit 1 : (Communication - Introduction)
Introduction to Professional Communication, Conversation and Listening

Unit 2 (Communication – Reading Skills)
Reading Skills for Effective Professional Communication: Introduction, SQ3R (Survey, Question, Read, Retrieve, and Review) Technique of Reading

Unit 3 (Communication - Writing Skills):
Written Business Communication: Writing Memos, Letters, Circulars and Notices, Communicating through Email

Unit 4 (Communication - Presentation)
Presentation Skills: Message development, content, projection, inflection, and delivery

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

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

	Programme Outcomes (POs)												Programme Educational Outcomes (PEOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PEO-1	PEO-2	PEO-3
CO-1					2					2					1
CO-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		6
Demonstrations		0
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		
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		2
1. Case Study Presentation	01	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
In-class assessments, Term Tests, Laboratory Examination/Written Examination, Presentations		2
Total Duration in Hours		**10**

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore-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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of CO's on each Component or Subcomponent of Evaluation:

	Component 1: CE (100% Weightage)	Component 2: SEE (0% Weightage)
Subcomponent▶	SC1	
Subcomponent Type ▶	In-Class Assessment	0 Marks
Maximum Marks▶	25	
CO-1	X	
CO-2	X	

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	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	--
4.	Analytical Skills	Face to face lectures, activities, , group discussions, assignment
5.	Problem Solving Skills	--
6.	Practical Skills	Face to face lectures, activities, , group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self- Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Dr. C.S.G. Krishnamacharyulu (2016) Business Communication, Himalaya Publishing House

b. Recommended Reading

1. V. Lesikar, John D. Pettit, Jr., Marie E. Flatley. (1999), Basic Business Communication, 8th Edition, Tata McGraw Hill

c. Websites

1. www.myenglishpages.com

d. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

10. Course Organization

Course Code	19FET509A	
Course Title	Professional Communication	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-80-453666666
	E-mail:	director.tsld@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Course Specifications: Artificial Neural Networks

Course Title	Artificial Neural Networks
Course Code	19MIC504A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Artificial Neural Networks (ANNs) represent connectionist models that get their computational capabilities through training from examples. ANNs generalize their processing knowledge into previously unseen situations; and thus, they perform well when the inputs are noisy, incomplete or inaccurate. This attribute of ANNs is well-suited for modelling tasks in challenging engineering problems. This module covers the various neural network architectures and algorithms, adaptive behaviour, associative learning, competitive dynamics and biological mechanisms. Several applications of ANNs including cognitive information processing, control, and signal analysis will be discussed. Special emphasis will be laid on the architecture and learning algorithms of deep neural networks which can model high-level abstractions in data by using multiple processing layers.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	3:1:1
Total Hours of Interaction	85
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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. Demonstrate an understanding of the various concepts and techniques of ANNs.
CO-2. Determine under which circumstances ANNs are useful in solving real-world problems.
CO-3. Discuss the main factors involved in achieving good learning and generalization performance in neural network systems.
CO-4. Build different kinds of ANNs, train them, evaluate their performance, and use them to solve complex problems.
CO-5. Evaluate whether neural networks are appropriate to a particular application.
CO-6. Analyze the steps needed to improve performance of the selected neural network.

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

4. Course Contents

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Unit 1 (Supervised Learning): Regression models, Linear regression, Error function, Polynomial regression, Parameters and hyperparameters, Underfitting, Overfitting, Testing, Regularization, Perceptron algorithm, Logistic classifiers.

Unit 2 (ANN Architecture): Biological inspiration, Models of ANNs, Learning and adaptation, Neural network learning rules, Single layer perceptrons, Training a single-neuron model, Limitations of single-layer ANNs, MultiLayered Perceptron (MLP), Training an MLP, Activation functions, Vanishing Gradient problem, Bias-Variance tradeoff.

Unit 3 (Support Vector Machines and Kernel Methods): Support vector planes, Loss function, Kernel method, Polynomial Kernel, Radial Basis Function (RBF) Kernel, Domain specific Kernels, Train and run time complexities, SVM Regression.

Unit 4 (Attractor Neural Networks): Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, Application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

Unit 5 (Self-organization Feature Map): Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self- organization Feature Maps, Growing Neural Gas.5. Course Map (CO-PO-PSO Map)

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	2	1			2											
CO-2	2	3														
CO-3	3					3		3		1			3			
CO-4	1	2				3	2					2		3		
CO-5			2	2	2				1		1				2	
CO-6			3		3			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		40
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		20
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course Workshop / Kitchen	00	

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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, Assignments

2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Assignments
4.	Analytical Skills	Assignments
5.	Problem Solving Skills	Assignments, Examination
6.	Practical Skills	Assignments
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Tests,Assignments, Examination
10.	Verbal Communication Skills	Group discussion
11.	Presentation Skills	Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignments
14.	Personal Management	--
15.	Leadership Skills	Group discussion

9. Course Resources

a. Essential Reading

1. Course notes
2. Zurada J. (1992). Introduction to Artificial Neural Systems. St. Paul, MN, USA. West Publishing Co.
3. Deng L. & Yu D. (2014). Deep Learning: Methods and Applications. Foundations and Trends in Signal Process. 7(3, 4).

b. Recommended Reading

1. Haykin S. (1998). Neural Networks: A Comprehensive Foundation. PTR, Upper Saddle River, NJ, USA, Prentice Hall.
2. Hagan M.T., Demuth H. B., & Beale M. (1997). Neural Network Design. Boston, MA, USA.PWS Pub. Co.
3. Demuth H. & Beale M. (2000). MATLAB neural network toolbox user's guide. Natick, MA, USA. The Math Works.Magazines and Journals

c. Websites

1. http://www.journals.elsevier.com/neural-networks.
2. http://cis.ieee.org/
3. http://lumiverse.io/series/neural-networks-demystified
4. http://www.deeplearningbook.org/
5. http://neuralnetworksanddeeplearning.com/
6. http://deeplearning.net/

10. Course Organization

Course Code	Artificial Neural Networks	
Course Title	19MIC504A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Course Specifications: Advanced Data Processing

Course Title	Advanced Data Processing
Course Code	19DSC505A
Course Type	Core Theory Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course aims to teach methods, techniques and tools for big data processing in current data science applications. Students shall be taught appropriate big data processing techniques, frameworks and tools for a big data. Big Data using a data processing workflow is covered. Design and synthesis of Big Data and complex data processing applications employing a wide variety of data models, representations, approaches, frameworks and libraries is covered. Students employ modern tools and platforms to develop big data processing solutions for applications and scenarios.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	3:1:1
Total Hours of Interaction	85
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** To choose appropriate data processing techniques, frameworks and tools for a Big Data
- **CO-2.** To develop models for structured data using Big Data models
- **CO-3.** To design a Big Data processing application using modern data processing techniques, frameworks and tools
- **CO-4.** To synthesize a data processing application for big data
- **CO-5.** To analyze big data using a data processing workflow
- **CO-6.** To evaluate alternative solutions to a big data processing problem

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

4. Course Contents

Unit 1 (Big Data): Introduction to advanced data processing, Characteristics, applications and challenges. Real-Time and other complex data.

Unit 2 (Data models): Big Data, Real-Time, Semi-structured and Sparse Data Models:
NoSQL Models: Distributed data stores, CAP Theorem, speed at the expense of consistency and ACID properties, managing transactions and integrity. Column, Document, Key-Value, Graph and multi-model stores. Column-oriented data model: Advantages and limitations, column-oriented databases. Vector Space and Graph Data Models.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Unit 3 (Big Data Processing): Distributed Big Data processing: Hadoop clustered data processing model. Data processing using MapReduce framework and Resilient Distributed Datasets (RDDs). Distributed data processing on key-value stores, column-oriented, document, vector space and graph databases. Data stream processing. Design and implementation of Big Data processing pipelines and workflows.

Unit 4 (Sequence Data models): Modelling and representation of sequence data. Time series data models: data types, internal structure and models of time series. Other sequence data: symbolic and biological sequences.

Unit 5 (Domain based data processing): Processing Sequential Data: Special purpose and domain based data processing tools and libraries for time-series, social media feed, symbolic and bioinformatics sequences. Real-time data acquisition of time-series data. Filtering, statistical analysis, signal processing and simulation of time series data. Processing time series data using Big Data technology and its applications.

Unit 6 (Demonstrations and case studies):
Laboratory and Assignment activity: Design and synthesis of Big Data and complex data processing applications. Examples , Case studies etc.

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	1			2								3			
CO-2	2	3	3										3			
CO-3	1	2	3			3		3		2			3	3		
CO-4	3	2	3			3	2					1	3	3		
CO-5	3	3	2	1	2				2		3		3	3	2	
CO-6	3	3	3		3			2				2	3	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		40
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	05
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Assignments
4.	Analytical Skills	Assignments
5.	Problem Solving Skills	Assignments, Examination

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

9. Course Resources

a. Essential Reading

1. Course notes
2. Nandi, A., 2015, Spark for Python Programmers, Packt Publishing.
3. Radtka, Z., and Miner, D., 2016, Hadoop with Python, O'Reilly

b. Recommended Reading

1. McKinney, W., 2018, Python for Data Analysis, 2nd edn., O'Reilly
2. Best Practices in Data Cleaning by Osborne, Jason W
3. Introduction to Data Mining, 2nd ed., Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Bipin Kumar, published by Pearson, 2019, ISBN 978-0-13-312890-1
4. Cios, K. J., Pedrycz, W., Swiniarski, R.W., and Kurgan, L., 2007, Data Mining: A Knowledge Discovery Approach, Springer.

c. Magazines and Journals

1. https://epjdatascience.springeropen.com/
2. https://www.scimagojr.com/journalsearch.php?q=21100228068&tip=sid&clean=0
3. https://www.inderscience.com/jhome.php?jcode=ijds

d. Websites

1. https://www.youtube.com/playlist?list=PL8eNk_zTBST-gN6Y5E-5FZdARXjglYpyT
2. http://www.cse.msu.edu/~ptan/dmbook/software/
3. https://pandas.pydata.org/docs/user_guide/index.html
4. https://github.com/REMitchell/python-scraping

10. Course Organization

Course Code	Advanced Data Processing	
Course Title	19DSC505A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Course Specifications: Distributed Computing

Course Title	Distributed Computing
Course Code	19DSE501A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course prepares the students to comprehend the concurrent and distributed system issues in Data Science and Engineering, design and synthesize reliable and secure distributed and cloud computing applications. Models, architectures and algorithms to design and develop distributed systems laying emphasis on transactions, coordination, consensus, timing and synchronization are discussed in detail. Models, architectures and technologies of cloud computing for building scalable distributed systems and applications are covered.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** Discuss the distributed and cloud computing models for big data and their role in data science and engineering
- **CO-2.** Recommend appropriate protocols, techniques and infrastructure for designing distributed and cloud computing systems for big data
- **CO-3.** Discuss security challenges for big data computing in distributed environments and recommend appropriate solutions
- **CO-4.** Design distributed algorithms using appropriate protocols, techniques and infrastructure
- **CO-5.** Design and develop distributed and cloud computing application for big data using appropriate architectural models and techniques
- **CO-6.** Analyze timing, fault tolerance, safety and reliability of distributed and cloud computing systems

4. Course Contents

Unit 1 (Introduction): Key characteristics of big data, overview of big data computing, big data and cloud computing paradigms, role of parallel and distributed computing in big data science and engineering, cloud computing for data science and engineering, big data distribution on distributed environments (multi-cloud infrastructure, Hadoop Distribution File System (HDFS)), distributed systems and system models, distributed applications and systems, characteristics and challenges, architectural modes (client-server, peer-to-peer), fundamental models (interactive, failure and security models).

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

Unit 2 (Infrastructural Issues): Distributed Objects. Inter-Process Communication - Sockets, Remote Procedure Calls (RPC) and Remote Method Invocation (RMI). Middleware, Application servers and containers. Distributed File Systems. Design and implementation of distributed applications.

Unit 3 (Timing and Synchronization in Distributed Systems): Clocks, events and states in distributed systems. Clock synchronization. Logical time and logical clocks. Consistent runs and states. Global states. Global State computation. Coordination and Consensus: Group communication. Voting and election for coordination. Consensus. Reaching consensus.

Unit 4 (Distributed Transactions): Flat and nested distributed transactions. Transaction processing models. Commit Protocols. Distributed concurrency control. Design and development of distributed transactions. Distributed deadlocks: Analysis, detection and handling. Transaction Recovery: Requirements for recovery, recovery techniques. Transaction Concurrency - Analysis of concurrency issues in concurrent transactions. Transaction Serialization, Concurrency control techniques and their use. Application design using transactions.

Unit 5 (Parallel and Distributed Computing for big data): Brief introduction to parallel and distributed systems, storing, processing and analyzing big data: for storage, storage systems such as storage area network (SAN), network attached storage (NAS), distributed file systems, cloud storage; for processing parallel processing, processing systems based on Map Reduce paradigm; for analysis, Knowledge discovery database (KDD), On Line Analytic Processing (OLAP).

Unit 6 (Fundamental concepts of Distributed Computing for Big Data): Multithreading and Multiprocessing (concept and example), difference between multithreading and multiprocessing, parallelism, computing architecture in distributed computing – Flynn's taxonomy, Single instruction Single Data (SISD), Single Instruction Multiple Data (SIMD), Multiple Instruction Multiple Data (MIMD), Shared Memory – MIMD (SM-MIMD), Distributed Memory –MIMD (DM-MIMD), Scalability in distributed computing (scaling-up and scaling-out), Queuing network model for distributed computing (asynchronous communication, queue system and queue modelling); consistency, availability and partition tolerance (the CAP theorem and its applications)

Unit 7 (Distributed Computing for Big Data): Multithreading and Multiprocessing (concept and example), parallelism, computing architecture in distributed computing, Scalability in distributed computing (scaling-up and scaling-out), Queuing network model for distributed computing, consistency, availability and partition tolerance (the CAP theorem and its applications), Distributed database, distributed storage, Hadoop Distributed File System (HDFS), distributed computation, the ACID (atomicity, concurrency, isolation and durability) property; ACID and commit protocols, consistency, availability and partition tolerance (CAP), distributed caching systems.

Unit 8 (Distributed Computing for Big Data on Cloud): Primitives for concurrent programming, big data distribution on distributed environments (HDFS, cloud); Multi-cloud environments. Cloud computing paradigm - Data centers, hardware consolidation, virtual machines and orchestration. Elasticity and scalability. Cloud and Utility based costing; Cloud computing models - Infrastructure, Platform and Software as Service (IaaS, PaaS and SaaS). Choice of appropriate model; Public, private and hybrid cloud systems, major cloud platforms.

Unit 9 (Security challenges in Big Data Computing in Distributed Environments): Threats and security requirements of distributed systems. Security Policies and Security Mechanisms Infrastructure based security - secure computations, secure non-relational data stores; Data privacy – privacy preservation of distributed systems and distributed data, cryptography - private and public key cryptography techniques for encryption, authentication, authorization and digital signatures, hybrid cryptography

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 058.

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

protocols, securing distributed applications; control mechanisms, granular access control; Data integrity and management – secure transactions and transaction logs; reactive security, input validation at distributed nodes, real-time security monitoring, countermeasures.

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	1	2	2	2	3								3			
CO-2	1	2	3	3	2								3			
CO-3		2		2		3		3		2			3			
CO-4		2				3	3					2		3		
CO-5			3	2	3				2		3			3	2	
CO-6			3		3			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		40
Demonstrations		15
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		05
1. Solving Numerical Problems	05	
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		10

Total Duration in Hours	70

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Assignments
4.	Analytical Skills	Assignments
5.	Problem Solving Skills	Assignments, Examination
6.	Practical Skills	Assignments
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Tests,Assignments, Examination
10.	Verbal Communication Skills	Group discussion
11.	Presentation Skills	Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignments

14.	Personal Management	--
15.	Leadership Skills	Group discussion

9. Course Resources

a. Essential Reading

1. Course notes
2. Mazumdar S., Bhadoria R. S., and Deka G. C., (2017) Distributed Computing in Big Data Analytics : Concepts, Technologies and Applications, Springer.
3. Colouris G., Dollimore J., and Kingberg T., (2009), Distributed Systems Concepts and Design, Fourth Edition, Addison Wesley

b. Recommended Reading

1. Ben-Ari, M. (2006) Principles of Concurrent and Distributed Programming, 2nd edn, Addison-Wesley
2. Roscoe, A. W. (2010) The Theory and Practice of Concurrency, Revised edition [Online] available from http://www.cs.ox.ac.uk/ucs/tpc2010.pdf [3 June 2019]

c. Magazines and Journals

1. https://journalofbigdata.springeropen.com
2. https://epjdatascience.springeropen.com/
3. https://www.scimagojr.com/journalsearch.php?q=21100228068&tip=sid&clean=0
4. https://www.inderscience.com/jhome.php?jcode=ijds

d. Websites

1. https://people.duke.edu/~ccc14/sta-663/DistributedComputing.html
2. https://onlinelibrary.wiley.com/doi/full/10.1002/cpe.3813#:~:text=Spark%20is%20a%20relevant%20parallel,of%20scalable%20and%20resilient%20applications.&text=The%20selection%20of%20RDD%20partitions,in%20the%20whole%20application%20performance.
3. https://link.springer.com/chapter/10.1007/978-3-319-97598-6_14
4. https://www.dummies.com/programming/big-data/engineering/distributed-computing-basics-for-big-data/
5. https://datascience.stackexchange.com/questions/81/parallel-and-distributed-computing

10. Course Organization

Course Code	Distributed Computing	
Course Title	19DSC501A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

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

Course Specifications: Natural Language Processing

Course Title	Natural Language Processing
Course Code	19DSE502A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course enables the students to understand and apply the theory and methods of natural language processing (NLP) in practice. NLP systems understand and produce human language for applications such as information extraction, machine translation, automatic summarization, question-answering, and interactive dialog systems. The course covers knowledge-based and statistical approaches to language processing for syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** Describe the fundamental mathematical models and algorithms for NLP.
- **CO-2.** Explain major natural language processing challenges in various domains.
- **CO-3.** Discuss statistical language models and machine learning algorithms to extract information from various text data.
- **CO-4.** Apply mathematical models and algorithms in the design and implementation for NLP.
- **CO-5.** Recommend natural language processing tools currently available for unstructured text processing.
- **CO-6.** Implement methods for syntax and semantic analysis in NLP.

4. Course Contents

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Unit 1 (Introduction): NLP tasks in syntax, semantics, and pragmatics, Applications such as information extraction, question answering, and machine translation, The problem of ambiguity, The role of machine learning, Brief history of the field

Unit 2 (Regular Expressions, Text Normalization, Edit Distance, N-gram Language Models): Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance. N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing

Unit 3 (Vector Semantics): Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Applications of the TF-IDF vector model, Optional: Pointwise Mutual Information (PMI), Word2vec, Visualizing Embedding.

Unit 4 (Grammar): Markov Models, Hidden Markov Models, Part-of-Speech Tagging: The Information Sources in Tagging, Markov Model Taggers, Hidden Markov Model Taggers, Probabilistic Context Free Grammars: The Probability of a String, Probabilistic Parsing

Unit 5 (Syntactic Parsing, Semantic Parsing): Ambiguity, CKY Parsing: A Dynamic Programming Approach, Partial Parsing, Statistical Parsing, Probabilistic Context-Free Grammars, Dependency Parsing; Semantic Parsing: Information Extraction, Named Entity Recognition, Relation Extraction, Extracting Times, Extracting Events and their Times

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3		2			1		1	1			3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3		2				1	1			3			
CO-5	3	3	3		2			1	1	1		1	3	3	1	
CO-6	3	3	3	1	1	1			1	1	1		3	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		30
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		10
1. Solving Numerical Problems	10	

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

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 054

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

Practical Work		10
1. Course Laboratory	00	
2. Computer Laboratory	10	
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		10
Total Duration in Hours		**70**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ▶	25	25	25	25	
CO-1	×	×			×
CO-2	×	×			×
CO-3	×	×			×
CO-4			×	×	×
CO-5			×	×	×
CO-6			×	×	
The details of SC1, SC2, SC3 or SC4 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.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

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

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 and Demonstrations
2.	Understanding	Classroom Lectures, Tutorials, Assignment and Demonstrations
3.	Critical Skills	Assignment
4.	Analytical Skills	Classroom Lectures, Tutorials and Assignment
5.	Problem Solving Skills	Tutorials and Assignment
6.	Practical Skills	Tutorials and Assignment
7.	Group Work	Assignment, Tutorials
8.	Self-Learning	Assignment
9.	Written Communication Skills	Tests, Examination and Assignment
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Interaction with peers, instructors and tutors
13.	Information Management	Assignment and Examination
14.	Personal Management	Peer interaction
15.	Leadership Skills	Group discussion

9. Course Resources

a. Essential Reading

1. Course notes
2. Jurafsky, D., and Martin, J.H. (2008). Speech and Language Processing (2nd Edition). Upper Saddle River, NJ: Prentice Hall
3. Manning, C. D., Manning, C. D., & Schütze, H. (1999). Foundations of statistical natural language processing. MIT press.

b. Recommended Reading

1. Bird, S., Klein, E. and Loper, E., (2009). Natural language processing with Python: analyzing text with the natural language toolkit. " O'Reilly Media, Inc.".
2. Martin, J. H., & Jurafsky, D. (2009). Speech and language processing: An introduction to natural language processing, computational linguistics, and speech recognition. Upper Saddle River: Pearson/Prentice Hall.
3. Mitkov, R. (Ed.). (2004). The Oxford handbook of computational linguistics. Oxford University Press.
4. Deng, L., & Liu, Y. (Eds.). (2018). Deep Learning in Natural Language Processing. Springer

c. Magazines and Journals

Registrar (Evaluation)
M.S. Ramaiah University of Applied Sciences
Bangalore-560 054

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

1. ACM Transactions on Algorithms
2. Journal of Algorithms

d. **Websites**

1. NPTEL Course Materials
2. www.ieee.org
3. https://www.coursera.org/

e. **Other Electronic Resources**

1. https://www.coursera.org/

10. Course Organization

Course Code	19DSE502A	
Course Title	Natural Language Processing	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	49065555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Course Specifications: Text Mining and Visualization

Course Title	Text Mining and Visualization
Course Code	19DSE503A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Given the dominance of text information over the Internet, mining high-quality information from text becomes increasingly critical. The actionable knowledge extracted from text data facilitates in a broad spectrum of areas, including business intelligence, information acquisition, social behavior analysis and decision making. This course enables the students to understand and apply important methods of text mining including: basic natural language processing techniques, document representation, text categorization and clustering, document summarization, sentiment analysis, social network and social media analysis, probabilistic topic models and text visualization.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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. To apply basic methods for information extraction for retrieval of textual data
CO-2. To apply text processing techniques to prepare documents for statistical modelling
CO-3. To develop proper machine learning models for analyzing textual data and correctly interpreting the results
CO-4. To use relevant machine learning models for text prediction
CO-5. To evaluate the performance of machine learning models for textual data
CO-6. To visualize text mining and machine learning results for various application

4. Course Contents

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Unit 1 (An Introduction to Text Mining): Introduction, Algorithms for Text Mining, Future Directions

Unit 2 (Information Extraction from Text): Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction; Text Summarization Techniques: Topic Representation Approaches, Influence of Context, Indicator Representations and Machine Learning for Summarization, Selecting Summary Sentences

Unit 3 (Text Clustering Algorithms): Feature Selection and Transformation Methods, Distance-based Clustering Algorithms, Word and Phrase-based Clustering, Probabilistic Document Clustering and Topic Models, Online Clustering with Text Streams, Clustering Text in Networks, Semi-Supervised Clustering

Unit 4 (Dimensionality Reduction and Topic Modeling): Latent Semantic Indexing, Topic Models and Dimension Reduction, Interpretation and Evaluation

Unit 5 (Text Classification Algorithms): Feature Selection for Text Classification, Decision Tree Classifiers, Rule-based Classifiers, Probabilistic and Naive Bayes Classifiers, Linear Classifiers , Proximity-based Classifiers, Classification of Linked and Web Data, Meta-Algorithms for Text Classification

Case Study:
Mining Text Streams, Opinion Mining and Sentiment Analysis, Text Analytics in Social Media, Text Mining in Multimedia, Trans lingual Mining from Text Data

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3		2			1		1	1			3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3		2				1	1		1	3			
CO-5	3	3	3		2			1	1	1	1		3	3	1	
CO-6	3	3	3	1	1	1			1	1			3	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

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		05
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		10
1. Case Study Presentation	05	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	03	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	SC4	
Subcomponent Type ▶	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ▶	25	25	25	25	
CO-1	×	×			×
CO-2	×	×			×
CO-3	×	×			×
CO-4	×		×	×	×
CO-5		×	×	×	×
CO-6			×	×	
The details of SC1, SC2, SC3 or SC4 are presented in the Programme Specifications Document.					

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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 and Demonstrations
2.	Understanding	Classroom Lectures, Tutorials and Demonstrations
3.	Critical Skills	Assignment
4.	Analytical Skills	Classroom Lectures, Tutorials and Assignment
5.	Problem Solving Skills	Tutorials and Assignment
6.	Practical Skills	Assignment
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Tests, Assignment and Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Interaction with peers, instructors and tutors
13.	Information Management	Assignment, Examination
14.	Personal Management	Interaction and requirements of discipline
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course Notes
2. Aggarwal, C.C. and Zhai, C. eds., 2012. Mining text data. Springer Science & Business Media

b. Recommended Reading

1. Bird, S., Klein, E. and Loper, E., 2009. Natural language processing with Python: analyzing text with the natural language toolkit. " O'Reilly Media, Inc.".
2. Sarkar, D., 2016. Text Analytics with python. Apress.
3. Zhai, C. and Massung, S., 2016. Text data management and analysis: a practical introduction to information retrieval and text mining. Morgan & Claypool

c. Magazines and Journals

1. www.ieee.org

d. Websites

1. www.ieee.org
2. https://www.coursera.org/

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

e. **Other Electronic Resources**

10. Course Organization

Course Code	19DSE503A		
Course Title	Text Mining and Visualization		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	**Phone:**	+91-804-906-5555	
	E-mail:	hod.ec.et@msruas.ac.in	
Course Specifications Approval Date	June 2022		
Next Course Specifications Review Date	June 2026		

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

Course Specifications: Big Data for Software Defined Networking

Course Title	Big Data for Software Defined Networking
Course Code	19DSE504A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Software Defined Networking (SDN) is an emerging networking technology that has been rapidly changing the networking industry and networking research. By separating the network control from the underlying packet forwarding hardware, a global approach to specify complex networking tasks in one single control framework is enabled, which promises significant simplification of network management, control, and monitoring. Students will learn the fundamentals of SDN, related protocols, controllers and implementations. Practical SDN implementations will be demonstrated.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** Describe the limitations of traditional networking architectures engineering
- **CO-2.** Explain the significance and role of SDN architecture in present day networks
- **CO-3.** Discuss and recommend SDN based protocols, controllers and implementations for networking
- **CO-4.** Develop and conceptualize SDN based solutions for sample use cases used in the industry
- **CO-5.** Evaluate the performance of machine learning models for textual data
- **CO-6.** Analyze the functionality and performance of the developed SDN based solutions for networking use cases

4. Course Contents

Unit 1 (Introduction): Limitations of traditional networking architecture, evolution of Software Defined Networking (SDN), architecture of SDN, SDN for scalability: data centers, service provider networks, Internet Service Provider (ISP) automation, SDN for reliability: Quality of Service (QoS) and service availability, SDN for consistency: configuration management and access control. SDN advantages and limitations.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Unit 2 (Control and Data Plane Separation): Concepts, advantages and disadvantages, virtual networking, SDN architecture north-bound interface, south-bound interface, east-west protocol, distributed control planes and centralized control planes, Use-cases such as network access control, virtual customer edge, datacenter optimization, centralized and distributed control and data planes, SDN controllers, OpenFlow protocol and applications of SDN.

Unit 3 (The Open Flow Protocol): Traditional Forwarding, OpenFlow Forwarding and Messages, Proactive verses Reactive Flow Entries, OpenFlow flow tables, OpenFlow Switch, Traffic matching, OpenFlow Ports, Packet Ingress Port, OpenFlow Physical Port, OpenFlow Logical and Reserve Ports, OpenFlow switch and Hybrid switches, Normal Forwarding in a VLAN and OpenFlow Based Forwarding.

Unit 4 (Network Programmability): Introduction, Management Interface, Application-Network Divide, Modern Programming Interface vs Traditional Programming Interface, Modern Orchestration).

Unit 5 (Use Cases): Input Traffic Monitoring, Classification, Bandwidth Scheduling, Manipulation, Calendaring, Data Center Overlays, Big Data and NFV.

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2	2	3								3			
CO-2	2	2	3	3	2								3			
CO-3	2	2		2		3		3		2			3			
CO-4		2				3	3					2		3		
CO-5			3	2	3				2		3			3	2	
CO-6			3		3			2				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		30
Demonstrations		15
1. Demonstration using Videos	08	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	07	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	

Registrar (I/c)
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	10
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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.Tech. (Data Science and Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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:

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

9. Course Resources

a. Essential Reading

1. Course notes
2. Nadeau T.D. and Gray K., 2013, SDN: Software Defined Networks, O'Reilly Stallings W., (2016), Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson.
3. Azoldolmolky S., 2013, Software Defined Networking with OpenFlow, PACKT publishing

b. Recommended Reading

1. Kreutz, D., Ramos, F. M., Verissimo, P., Rothenberg, C. E., Azodolmolky, S., & Uhlig, S. (2015). Software-defined networking: A comprehensive survey. Proceedings of the IEEE, 103(1), 14-76
2. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98
3. Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634

c. Magazines and Journals

1. IEEE Transactions on Big Data
2. IEEE Networks
3. Journal of Communication and Networks
4. IEEE Communications Magazine

d. Websites

1. www.sdxcentral.com
2. www.opennetworking.org
3. www.opendaylight.org
4. www.openvswitch.org
5. www.sigcomm.org
6. www.ieee.org

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

10. Course Organization

Course Code	Big Data for Software Defined Networking	
Course Title	19DSE504A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

Course Specifications: Time Series Analysis

Course Title	Time Series Analysis
Course Code	20DSE507A
Course Type	Professional Core Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the theory and practice of time series analysis and forecasting. Most of the real time applications generate time series data and the analysis of this data is highly significant. Forecasting time series data reveal future trends in the data and helps in anticipating future trend and subsequent decision making. Students will be taught to model and forecast time series data with examples and case studies using R.

2. Course Size and Credits:

Number of Credits	04
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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.** Explain time series data with an appropriate statistical framework and examples
- **CO-2.** Perform appropriate preprocessing and carryout exploratory data analysis on time series data
- **CO-3.** Apply appropriate filters, smoothing techniques on time series data and interpret the results
- **CO-4.** Discuss appropriate statistical modelling techniques for forecasting time series data
- **CO-5.** Apply and forecast time series data using stationary, non-stationary, multivariate time series models
- **CO-6.** Use R to model, forecasts and interpret the results for time series data

4. Course Contents

UNIT 1

Time Series Data: representation-graph and table form, time series data types and components, plots, trends and seasonal variation, Decomposition of time series data

Correlations: Expectation and the ensemble – expected value, ensemble and stationary, ergodic series , variance function , autocorrelation; the correlogram – examples

UNIT 2

Forecasting Strategies: leading Variables and associated variables-examples; Bass Model-model definition, interpretation, Example; Exponential Smoothing and Holt-Winters Method,

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

Autoregressive model – definition, stationary and non-stationary AR processes, partial auto correlations, examples

UNIT 3

Stationary Models: Moving Average Models- fitted MA models; Mixed Models- ARMA process- definition, examples and empirical analysis; ARIMA model –properties, forecasting using ARIMA model- examples

UNIT 4

Regression- Linear models- definition, examples; fitted models- autocorrelation and the estimation of sample statistics; Generalized Least Squares- GLS to simulated example, confidence interval; Forecasting From regression- example.

UNIT 5

Non-Stationary models- seasonal ARIMA model – procedure and example; ARCH model – modeling volatility – fitting procedure and example; GARCH model- procedure and example. Introduction to Long Memory processes: Spectral Analysis; Multivariate Models; State Space Models

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	1	1	1	2	2						3	2	1	
CO-2	2	2	1	1	1	2	2						3	2	1	
CO-3	2	2	1	1	1	2	2						3	2	1	
CO-4	2	2	1	1	1	2	2						3	2	1	
CO-5	2	2	1	1	1	2	2						3	2	1	
CO-6	2	2	1	1	1	2	2						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		45
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		
1. Solving Numerical Problems	30	
Practical Work		00

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

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

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	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		10
Total Duration in Hours		**70**

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.Tech. (Electronics and Communication Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Group Task	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X	X			X
CO-2	X	X			X
CO-3	X	X			X
CO-4			X	X	X
CO-5			X	X	X
CO-6			X	X	
The details of SC1, SC2, SC3 or SC4 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.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

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	Activity chosen by student
2.	Understanding	Activity chosen by student
3.	Critical Skills	Activity chosen by student
4.	Analytical Skills	Activity chosen by student
5.	Problem Solving Skills	Activity chosen by student
6.	Practical Skills	Activity chosen by student
7.	Group Work	Activity chosen by student
8.	Self-Learning	Activity chosen by student
9.	Written Communication Skills	Activity chosen by student, writing report/paper
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Activity chosen by student
13.	Information Management	Activity chosen by student
14.	Personal Management	Activity chosen by student
15.	Leadership Skills	Activity chosen by student

9. Course Resources

a. **Essential Reading**

b. **Recommended Reading**
c. **Magazines and Journals**
d. **Websites**
e. **Other Electronic Resources**

10. Course Organization

Course Code	Time Series Analysis	
Course Title	20DSE507A	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.ec.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

Course Specifications: Big Data and Healthcare

Course Title	Big Data and Healthcare
Course Code	19DSE505A
Course Type	Professional Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

Students shall be taught to describe the promise and potential of big data analytics in healthcare, nascent field of big data analytics in healthcare. To discuss the benefits, outlines an architectural framework, methodology, along with machine learning algorithms design and applications of learning in healthcare. The big data challenges in healthcare and practical applications shall be discussed.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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. To discuss patient data for various diseases such as Diabetes and the medical background that is required for applying data science and AI; to discuss data capturing methods for healthcare.

CO-2. To discuss big data challenges, feature extraction and selection, key machine learning algorithms and their use and implementation in healthcare systems.

CO-3. To select learning methods, algorithms and tune them for use in healthcare.

CO-4. To design and implement machine learning systems for healthcare; to identify and apply deep learning algorithms for healthcare.

CO-5. To integrate data science and AI in healthcare through best practices, feedback loops and intelligent agents; to design for scalability, privacy and appropriate visualization; to discuss ethical aspects of intelligent systems.

CO-6. To summarize current trends and future work in Big Data for healthcare through a literature survey on chosen topics of Data Science, AI and healthcare, from standard journals and from discussions in seminars

4. Course Contents

Unit 1 (Medical Science of Diseases): Required level of overview, of medical science of diseases such as Diabetes, Cancer and Alzheimer's, for Data Science students

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Unit 2 (Big Data Challenges in Healthcare): Healthcare Informatics Processing pipeline; Data capturing, Storing, Sharing, Analyzing; overview of image processing, Feature extraction and selection in Healthcare; Key machine learning algorithms that can be applied in healthcare in different stages of decision making for patients; Implementation of machine learning algorithms in healthcare systems; selection of learning methods, algorithms and tuning; application of deep learning in healthcare; searching; decision support; ethical aspects of intelligent systems in healthcare; implementation of machine learning systems for healthcare; best practices; intelligent agents; future of healthcare; scalability, privacy and visualization.

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	1			2											
CO-2	1	2														
CO-3	3					3		3		1			3			
CO-4	3	2				3	2					1		3		
CO-5			3	2					1		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		30
Demonstrations		05
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	00	
2. Computer Laboratory	15	
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	05	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

5. Group Discussions	00	
6. Discussing Possible Innovations	05	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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.Tech. (Artificial Intelligence and Machine Learning) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation					
	Component 1: CE (50% Weightage)				Component 2: SEE (50% Weightage)
Subcomponent ►	SC1	SC2	SC3	SC4	
Subcomponent Type ►	Term Test	Term Test	Assignment	Assignment	100 Marks
Maximum Marks ►	25	25	25	25	
CO-1	X				X
CO-2	X	X			X
CO-3	X	X	X	X	X
CO-4			X	X	X
CO-5			X	X	X
CO-6				X	X
The details of SC1, SC2, SC3 or SC4 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, Assignments
2.	Understanding	Classroom lectures, Assignments

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Course Specifications: Value Education

Course Title	Value Education
Course Code	19FET520A
Program	MTech
Course Type	Ability Enhanced Compulsory Course
Department	Directorate of Transferable Skills and Leadership Development
Faculty	Engineering and Technology

1. Course Summary

This course aims at sensitizing students to learn the importance of value education. It gives an insight about the Universal Brotherhood.

2. Course Size and Credits:

Number of Credits	00
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	10
Number of Weeks in a Semester	15
Department Responsible	Directorate of Transferable Skills and Leadership Development
Total Course Marks	25
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. Discuss the role of Values and Ethics in Self-Development
CO-2. Appreciate the importance of Universal Brotherhood

4. Course Contents

Unit 1 (Communication – Values, Ethics and Judgements)

- Values, Ethics and Self-Development; Awareness of self-destructive habits, Power of faith, Positive Thinking
- Value judgements – Stereotypes, prejudices and biases

Unit 2 (Communication – Sense of Duty)

- Sense of duty, Self-reliance, Confidence, Concentration, Discipline, Honesty, Truthfulness

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

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

- National Unity, Patriotism, Love for nature

Unit 3 (Communication – Character Development):

- Universal brotherhood and religious tolerance
- Character and Competence –Rational Thinking vs Blind faith

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

	Programme Outcomes (POs)												Programme Educational Outcomes (PEOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PEO-1	PEO-2	PEO-3
CO-1							2	3				2			2
CO-2	2								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		06
Demonstrations		00
2. 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		02
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	01	
6. Discussing Possible Innovations	00	
In-class assessments, Term Tests, Laboratory Examination/Written Examination, Presentations		02
Total Duration in Hours		**10**

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.Tech. 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of CO's on each Component or Subcomponent of Evaluation:

	Component 1: CE (100% Weightage)	Component 2: SEE (0% Weightage)
Subcomponent▶	SC1	
Subcomponent Type ▶	In-Class Assessment	0 Marks
Maximum Marks▶	25	
CO-1	X	
CO-2	X	

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	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	--
4.	Analytical Skills	Face to face lectures, activities, , group discussions, assignment
5.	Problem Solving Skills	--
6.	Practical Skills	Face to face lectures, activities, , group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self Learning	Course work, practice, assignment, group discussion

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**

1. Class Notes

b. **Recommended Reading**

c. **Websites**

d. **Other Electronic Resources**

1. Electronic resources on the course area are available on RUAS library

10. Course Organization

Course Code	19FET520A	
Course Title	Value Education	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-80-453666666
	E-mail:	director.tsld@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Course Specifications: Internship

Course Title	Internship
Course Code	19MIC521A
Course Type	Core Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to give students an experience of identifying an engineering problem, conceptualise a solution, perform basic design calculations, model, solve, analyse and demonstrate its performance in a virtual environment. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new engineering solution is required. The team need to demonstrate the working of the solution and write a technical report. Students are required to choose a project from students projects database available. Alternatively,Student can undergo internship in an industry, business organization, research organization or any other university on a topic of relevance during vacation after 6th semester with prior approval from the department head and faculty dean.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	120
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
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. Recognise the need for developing a new or improving an existing engineering product/system through an organised survey of literature
CO-2. Define engineering design specifications
CO-3. Design, model, solve, analyse the product/system to meet the design specifications
CO-4. Evaluate the performance of the modelled system and justify its performance
CO-5. Demonstrate the system working in a virtual environment and make a presentation
CO-6. Write a technical report Alternatively,
CO-7. Write a report on experiences during internship
CO-8. Make a presentation to a panel of examiners

4. Course Contents

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

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

Unit 1: Collection of relevant literature and review of literature

Unit 2: Interaction with the users and collection of data

Unit 3: Data Analysis, Formulation of a problem of suitable size

Unit 4: Product development planning, cost calculations

Unit 5: Detail design calculations

Unit 6: Choosing a modeling environment, learning the appropriate tools and techniques

Unit 7: Modelling, simulation and analysis of design

Unit 8: Defining performance parameters, Evaluation of performance, presentation performance characteristics, Verification of results

Unit 9: Developing a working model, testing the model and evaluating its performance Demonstration to the defined audience and making a presentation to the assessing team making a Technical presentation

Unit 10: Writing project report

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	3	2	1	2	3		1	3	3	3	3
CO-2	2	2	2				1	2	3		1	3	3	2	3
CO-3	2	1	2	2	2	2		2	3		1	2	3	2	3
CO-4	2		2		2	2			2			3	2	2	3
CO-5	2	1	1		2	2			3	3		3	1	2	3
CO-6	1							2	2	3		3	1		3
CO-7	2							2	3	3		2	1		3
CO-8	1							2	3	3		3	1		3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Approximate Duration in Hours
Literature collection, Review of literature, Deciding the sample, for data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	20
Development of design concept, Basic design calculations	20
Selection of tools, techniques and learning on how to use them	20
Modelling, Simulation, Analysis	20
Evaluation, Verification of results	20
Demonstration, Presentation and Technical Report Writing	20
Total Duration in Hours	120

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.Tech. (Electronics and Communication Engineering) 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, SC3 or SC4), COs are assessed as illustrated in the following Table.

	Component 1: Presentation (50% Weightage)	Component 2: Dissertation (50% Weightage)
Subcomponent ▶	SC1	
Subcomponent Type ▶	Mid-term	50 Marks
Maximum Marks ▶	50 Marks	
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	X
CO-6	X	X
CO-7	X	X
CO-8	X	X

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.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

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	Project Work
2.	Understanding	Project Work
3.	Critical Skills	Project Work
4.	Analytical Skills	Project Work
5.	Problem Solving Skills	Project Work
6.	Practical Skills	Project Work
7.	Group Work	Project Work
8.	Self-Learning	Project Work
9.	Written Communication Skills	Project Work
10.	Verbal Communication Skills	Project Presentation, Viva Voice
11.	Presentation Skills	Project Presentation
12.	Behavioral Skills	Project Work
13.	Information Management	Project Report
14.	Personal Management	Project Work
15.	Leadership Skills	Project Work

9. Course Resources

a. **Essential Reading**

1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of Project work"

b. **Recommended Reading**

1. Course Notes, Manuals of Tools and Techniques Chosen to Solve the Design Problem

c. **Magazines and Journals**

d. **Websites**

a. **Other Electronic Resources**

10. Course Organization

Course Code	19MIC521A	
Course Title	Internship1	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

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

Dean - Academics

Dean, Faculty of Engineering & Technology, M.S. Ramaiah University of Applied Sciences, Bangalore-560054

Course Specifications: Group Project

Course Title	Group Project
Course Code	19MICS22A
Course Type	Core Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is intended to provide student an opportunity to synergies their learning from the earlier courses through working in a team, sharing responsibilities, to conceiving, designing and fabricating a working prototype of a system related to an automotive application. The students will learn skills related to project identification, planning, management and execution, working in teams and verbal and written communication. During design, analysis and synthesis stage, they will get an opportunity to apply theoretical knowledge to develop real life product and prototyping stage will provide them experience of converting a design into a working system through use of various fabrication techniques available.

2. Course Size and Credits:

Number of Credits	8
Credit Structure (Lecture: Tutorial: Practical)	0
Total Hours of Interaction	330
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	200
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.** To Work in a team and undertake a project in their area of specialization
- **CO-2.** To Apply their knowledge of general and automotive engineering and application, develop a system for automotive application.
- **CO-3.** To apply appropriate research methodology while formulating a project
- **CO-4.** To Prepare specifications, design, analyse, synthesize, prototype and assess the system
- **CO-5.** To Prepare and present appropriate forms of audio-visual and verbal presentations, and written document, to describe the project, its execution and outcome

4. Course Contents

Unit 1 Team building, Team work and Leadership skills

Unit 2 Preparing design specifications, design, analysis and synthesis, design evaluation calculations

Unit 3 Costing, Finance Management, Project management

Unit 4 Procurement, prototype building and related manufacturing methods

Unit 5 Preparing and presenting audio-visual and verbal presentations and preparing written documents

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560 054

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

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	3	3		2					1	1			3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3		2				1	1			3			
CO-5	3	3	3		2				1	1			3			
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

6. Course Teaching and Learning Methods

Topics	Teaching methods	Hours
Critical Review, Problem Formulation and stating Objectives	Reading Journal papers , books and other relevant materials and problem formulation	20.00
	Presentation to Reviewers	5.00
System Design	Group work with supervisors guidance	30.00
System Modelling, Simulation and Analysis	Group work with supervisors guidance	60.00
Model Building, Instrumentation, Testing and Evaluation	Group work with supervisors guidance	100.00
Verification/Validation	Group work with supervisors guidance	50.00
Drawing Conclusions	Group work with supervisors guidance	10.00
Video creation, Presentation ,Thesis/Report Writing and Viva Voce	Presentation and Viva voce - Group	5.00
	Thesis/Report writing - Group	30.00
	Project Exhibition and Video creation - Group	10.00
	Tests/Examinations/Presentations	10.00
	Total	330.00

6. Course Assessment and Reassessment

Course Assessment will be followed as per section 23. Assessment and Grading of Programme Specifications. 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.

Note: The above time calculation is for each student and a group can consists of 4 students and total hours can be computed accordingly.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)	
Subcomponent ►	SC1	SC2	SC3	SC4
Subcomponent Type ►	Mid Term presentation	Final Presentation	Exhibition	Project Report
Maximum Marks ►	50	50	50	50
CO-1	X			X
CO-2	X			X
CO-3	X	X		X
CO-4		X		X
CO-5			X	X
CO-6			X	X

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	Project work
2.	Understanding	Project work
3.	Critical Skills	Project work
4.	Analytical Skills	Project work
5.	Problem Solving Skills	Project work
6.	Practical Skills	Project work
7.	Group Work	Project work
8.	Self-Learning	Project work
9.	Written Communication Skills	Project work
10.	Verbal Communication Skills	Project work
11.	Presentation Skills	Project work
12.	Behavioral Skills	Project work
13.	Information Management	Project work
14.	Personal Management	Project work
15.	Leadership Skills	Project work

8. Course Resources

a. **Essential Reading**

1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of Project work"
2. Assigned reading relevant to the group project

b. **Recommended Reading**

c. **Magazines and Journals**

1. https://link.springer.com/journals/a/1
2. https://ieeexplore.ieee.org/Xplore/home.jsp
3. https://dl.acm.org/

d. **Websites**

1. www.ieee.org

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

2. http://nptel.ac.in/

e. **Other Electronic Resources**

1. https://ocw.mit.edu/index.htm

9. Course Organization

Course Code	19MIC522A	
Course Title	Group Project	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

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

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

Course Specifications: Dissertation and Publication

Course Title	Dissertation and Publication
Course Code	19MIC523A
Course Type	Core Course
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course is intended to give an insight to the students on application of principles of research methodology, preparation of research project proposal, research project management, execution of research project and effective technical communication and presentation. It also emphasizes the need and the relevance of a structured approach to identify a research topic and undertake research. This course provides an opportunity for students to apply theories and techniques learnt during programme work. It involves in-depth work in the chosen area of study.

2. Course Size and Credits:

Number of Credits	10
Credit Structure (Lecture: Tutorial: Practical)	-
Total Hours of Interaction	600
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	400
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.** Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
- **CO-2.** Prepare and present a research proposal
- **CO-3.** Conduct research to achieve research objectives
- **CO-4.** Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- **CO-5.** Create research document and write research papers for publications
- **CO-6.** Defend the research findings in front of scholarly audience

4. Course Contents

Unit 1 Research Methodology
Unit 2 Information search, retrieval and review
Unit 3 Project definition and project planning
Unit 4 Use of conceptual models and frameworks Problem
Unit 5 solving and Evaluation Interpretations and drawing
Unit 6 Conclusions Proposing ideas or methods for further work
Unit 7 Thesis writing
Unit 8 Oral presentation

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 9 Authoring Research paper

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	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3		2					1	1			3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3		2				1	1			3			
CO-5	3	3	3		2				1	1			3			
CO-6	3	3	3		2				1	1			3			
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution																

6. Course Teaching and Learning Methods

Topics	Teaching methods	Hours
Information search, retrieval and review, Project definition and project planning	Reading Journal papers, books and other relevant materials and problem formulation	50.00
	Presentation to Reviewers	20.00
Use of conceptual models and frameworks	Individual work with supervisors guidance	60.00
Problem solving and Evaluation	Individual work with supervisors guidance	120.00
Interpretations and drawing conclusions	Individual work with supervisors guidance	100.00
Proposing ideas or methods for further work	Individual work with supervisors guidance	40.00
Presentation ,Thesis/Report Writing and Viva Voce, Authoring Research paper	Presentation and Viva voce	30.00
	Thesis/Report writing, Authoring research paper	150.00
	Video creation	15.00
	Tests/Examinations/Presentations	15.00
	Total	600.00

6. Course Assessment and Reassessment

Course Assessment will be followed as per section 23. Assessment and Grading of Programme Specifications. 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.

Note: The above time calculation is for each student and total hours can be computed accordingly.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

	Component 1: CE (50% Weightage)		Component 2: SEE (50% Weightage)	
Subcomponent ►	SC1	SC2	SC3	SC4
Subcomponent Type ►	Mid Term presentation	Final Presentation	Research Paper	Project Report
Maximum Marks ►	100	100	100	100
CO-1	X			X
CO-2	X			X
CO-3	X	X		X
CO-4		X		X
CO-5			X	X
CO-6			X	X

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	Project work
2.	Understanding	Project work
3.	Critical Skills	Project work
4.	Analytical Skills	Project work
5.	Problem Solving Skills	Project work
6.	Practical Skills	Project work
7.	Group Work	Project work
8.	Self-Learning	Project work
9.	Written Communication Skills	Project work
10.	Verbal Communication Skills	Project work
11.	Presentation Skills	Project work
12.	Behavioral Skills	Project work
13.	Information Management	Project work
14.	Personal Management	Project work
15.	Leadership Skills	Project work

8. Course Resources

a. **Essential Reading**

1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of individual Project work"
2. Assigned reading relevant to the individual project

b. **Recommended Reading**

c. **Magazines and Journals**

1. https://link.springer.com/journals/a/1
2. https://ieeexplore.ieee.org/Xplore/home.jsp
3. https://dl.acm.org/

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore

d. **Websites**
   1. www.ieee.org
   2. http://nptel.ac.in/

e. **Other Electronic Resources**
   1. https://ocw.mit.edu/index.htm

9. Course Organization

Course Code	19MIC523A	
Course Title	Dissertation and Publication	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	**Phone:**	+91-804-906-5555
	E-mail:	hod.cs.et@msruas.ac.in
Course Specifications Approval Date	June 2022	
Next Course Specifications Review Date	June 2026	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

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