RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Specifications

M. Tech. Programme

Programme: Machine Learning and Intelligent Systems	Department: Computer Science and Engineering

Faculty of Engineering & Technology

M.S. Ramaiah University of Applied Sciences

University House, New BEL Road, MSR Nagar, Bangalore – 560 054

www.msruas.ac.in

Programme Specification

Programme: M. Tech. in Machine Learning and Intelligent Systems	
Faculty	Engineering & Technology
Department	Computer Science and Engineering
Programme	Machine Learning and Intelligent Systems
Dean of Faculty	Prof.Arulanantham
HOD	Prof.PVR Murthy

	1.	**Title of the Award**
		M. Tech. in Machine Learning and Intelligent Systems
	2.	**Modes of study**
		Full Time
	3.	**Awarding Institution / Body**
		M. S. Ramaiah University of Applied Sciences – Bengaluru, India
	4.	**Joint Award**
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	5.	**Teaching Institution**
		Faculty of Engineering & Technology
		M S Ramaiah University of Applied Sciences - Bengaluru, India
	6.	**Date of Programme Specification**
		20/05/2019
	7.	**Date of Programme Approval by the Academic Council of MSRUAS**
		24/07/2019
	8.	**Next Review Date**
		May 2021
	9.	**Programme Approving Regulatory Body and Date of Approval**
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	10.	**Programme Accrediting Body and Date of Accreditation**
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	11.	**Grade Awarded by the Accreditation Body**
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	12.	**Programme Accreditation Validity**
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	13.	**Programme Benchmark**
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14. Rationale for the Programme

Artificial Intelligence(AI) as a subject of study has existed since the 1960s and many AI programs were developed using LISP(List Processing Language) decades ago. AI traditionally has been based on planning, logic and reasoning. Learning an appropriate function or rules from data has been a problem of great interest since decades, however, its importance grew leaps and bounds with the recent advent of Big Data and enormous computing power made available with advancements in computer architecture and networks. Machine learning techniques such as supervised learning and unsupervised learning are so widely used today that it is extremely important that the underlying theory and practice are taught to students to prepare them not only for industrial, R&D jobs but also academia. Artificial Neural Networks and Deep learning are being used on a regular basis to solve challenging problems that are considered hard and that require intelligence. For example, identification of genes causing certain diseases such as cancer and Alzheimer's disease is a problem that is actively pursued today applying deep learning. There is hardly any human endeavor left out of the applications being investigated and developed using Machine Learning techniques. There is a strong need for a programme in Machine Learning and Intelligent Systems for a post-graduate student to be able to go in-depth into Machine Learning and Deep Learning algorithms and architectures so as to apply the knowledge in various domains such as Robotics, Computer vision, Healthcare and Education and conduct research to solve challenging problems and improve the state of art. There exists a strong need for a curriculum that while providing required breadth also provides adequate depth in theory and practice of Machine Learning to enable students to innovate in their respective spheres of professional activities augmenting the quality of human life.

15. **Programme Aim**

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of machine learning and intelligent 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 machine learning and intelligent systems, academics, research or take up entrepreneurial route.

16. **Programme Objectives**

The programme introduces the principles and working of machine learning and intelligent systems. It enhances the students' knowledge on design, development and testing of various machine learning algorithms and systems using industry standard tools.
It is structured in such a way that the students will be able to build intelligent systems and evaluate machine learning algorithms for domain specific applications.

The objectives of the programme are to train and educate the students on the following :

1. State-of-the-art machine learning algorithms and intelligent systems
2. Principles and concepts of pattern recognition, computational intelligence, probabilistic graphical models, neural networks and deep learning algorithms
3. Development of algorithms for machine learning tasks
4. Implementation of machine learning algorithms using industry standard tools
5. Construction and adaptation of intelligent systems using machine learning algorithms for domain specific applications
6. Industry practice, process and standards giving general perspectives as well as opportunities for a career in development of machine learning algorithms
7. Teamwork, lifelong learning and continuous improvement
1.

17. **Intended Learning Outcomes of the Programme**

The Intended Learning Outcomes (ILOs) are listed under four headings:
1. Knowledge and Understanding, 2. Cognitive Skills 3. Practical Skills and 4. Capability / Transferable Skills.

1. **Knowledge and Understanding**

After undergoing this programme, a student will be able to:

KU1: Discuss the fundamental principles of machine learning algorithms

KU2: Discuss the algorithms related to pattern recognition, computational intelligence, statistical learning, probabilistic graphical models, neural networks, and deep learning

KU3: Discuss the fundamental principles of pattern recognition and its importance to build intelligent systems

KU4: Discuss the application of machine learning algorithms to build intelligent systems in various domains such as computer vision, speech processing, text mining and biomedical.

2. **Cognitive Skills**

After undergoing this programme, a student will be able to:

CS1:	Analyze the performance of various pattern recognition and computational intelligent algorithms
CS2:	Develop machine learning algorithms using statistical learning, probabilistic graphical models, neural networks and deep learning
CS3:	Apply machine learning algorithms to specific applications in computer vision, speech processing, text mining and biomedical image processing
CS4:	Evaluate machine learning algorithms based on performance metrics

3. Practical Skills

After undergoing this programme, a student will be able to:

PS1:	Implement machine learning algorithms for various domain-specific applications
PS2:	Use standard simulation software tools to build machine learning algorithms and intelligent systems
PS3:	Perform tests to evaluate pattern recognition and machine learning algorithms
PS4:	Construct and adapt intelligent systems for various domain specific applications using machine learning algorithms

4. Capability / Transferable Skills

After undergoing this programme, a student will be able to:

TS1:	Manage information, develop technical reports and make presentations
TS2:	Build, Manage and Lead a team to successfully complete a project and communicate across teams and organizations to achieve professional objectives
TS3:	Work under various constraints to meet project targets
TS4:	Adopt to the chosen profession by continuously upgrading his/her knowledge and understanding through Life-long Learning philosophy

18. Programme Structure

The Programme consists of four terms as shown below. A student is required to successfully complete the following modules and earn credits for the award of the degree.

Complete details of each of the modules such as ILO's, content, resources, teaching-learning processes and other related information are outlined in Module Specification of the respective programme.

(Total 44 credits : 06 core courses, total 26 credits and 4 elective courses, total 16 credits spread in first two semesters)

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	Applied Mathematics	4			4	100
2	19DSC501A	Programming for Data Science	3		2	4	100
3	19DSC502A	Data Mining	3	2		4	100
4	19MIC502A	Artificial Intelligence	3		2	4	100
5	19MIE501A	*Computational Intelligence*	3		2	4	100
7	19FET508A	Research Methodology & IPR	2	--	--	2	50
8	19FET509A	Professional Communication	1	--	--	0	
	19		**2**	**6**	**22**		**550**
	Xx hours						
	Minimum	**18**		**Maximum**	**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	4	1		5	100
2	19MIC505A	Pattern Recognition	4	1		5	100
4	19MIE502A	*Deep Learning*	3		2	4	100
5	19MIE503A	*Probabilistic Graph Models*	3	1		4	100
6	19MIE504A	*AI for Healthcare*	3	1		4	100
9	19FET510A	Value Education	1			0	
	XX		**X**	**X**	**22**		**600**
	XX hours						
	Minimum	**18**		**Maximum**	**24**		

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
3	19MIC523A	Dissertation and Publication Phase 1					
Total					**25**	**12**	**300**
Total number of contact hours per week			**XX hours**				
Number of credits can be registered			**Minimum**	**XX**		**Maximum**	**XX**

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 Phase 2			24	24	400
Total					**24**	**24**	**400**
Total number of contact hours per week			**24 hours**				
Number of credits can be registered			**Minimum**	**24**		**Maximum**	**24**

Elective Modules List			
Stream / Specialization	S. No.	Module Code	Module Title
Stream-1: AI for Healthcare	E21	19MIE501A	Computational Intelligence
	E22	19MIE502A	Deep Learning
	E23	19MIE503A	Probabilistic Graphical Models
	E24	19MIE504A	AI for Healthcare
Stream-2: AI for Robots	E31	19MIE501A	Computational Intelligence
	E32	19MIE502A	Deep Learning
	E33	19MIE505A	Computer Vision
	E34	19MIE506A	AI for Robots

19. **Programme Delivery Structure**

   A Programme is delivered from Monday to Saturday of the week as per the Time-Table for every batch.

20. **Teaching and Learning Methods**

   The module delivery comprises of a combination of few or all of the following:
   1. Face to Face Lectures using Audio-Visuals
   2. Workshops, Group Discussions, Debates, Presentations
   3. Demonstrations
   4. Guest Lectures
   5. Laboratory/Field work/Workshop
   6. Industry Visit
   7. Seminars
   8. Group Exercises
   9. Project Exhibitions
   10. Technical Festivals

21. **Modules**

   Programme has six Professional core courses (PM1- PM6), four Professional elective courses (PE1 – PE4), two audit courses (NC), and one compulsory course (CC) followed by Group Project, Internship and Dissertation & Publication courses.

   Core courses (PC1- PC6) are Programme Specialization courses which normally include both theory and laboratory sessions. Alternate activities are planned in case of laboratory sessions do not exist in a module.

   Compulsory course (CM) is Research Methodology and IPR course which is mandatory.

   All courses of the programmes are categorized as indicated in the **Annexure I.**

22. **Electives**   **Electives**

   There are 4 electives (PE1 – PE4) 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. **Group Project**

   The main objective of group project is to provide an ambiance to work in groups towards achieving a common goal. A group shall have up to 5 students. In case of Group Project work is based on inter-disciplinary in nature, team can be constituted with members from across departments of the Faculty.

   The students are required to develop a report for assessment and also need to demonstrate the working of the product. The IPR rights of all such work lies with the University only. The project should be approved by a committee constituted by respective HoDs before the start of the project. For further details related to the Group Project refer to Module Specification of the respective programmes

24. **Industry Internship/Other Activities**

   A student can opt for an internship in an industry, a business or research organization during the module.

   Alternately, can undertake a mini-project requiring self-directed study that can be perused within the affiliated Faculty.

Prior approval of the internship / mini-project by the HoD and Dean is mandatory. It is also necessary for the student to submit a report and make a presentation to the members of the panel constituted by the HoD for assessment.

For further details related to this module, please refer to Module Specification of the respective programmes.

25. **Dissertation and Publication**

This module has two parts – Dissertation and Publication.

Every student, has to undertake the dissertation work individually on a chosen relevant topic. The topic needs to be approved by the committee constituted by HoD.

Publication is a stage wherein dissertation work of the student is converted into a technical paper to be published in reputed conferences/journals.

For further details related to the this module refer to Module Specifications of the respective programmes

26. **Course Assessment**

1. Every course will be assessed for a weight of 100%
2. There are two components-Component-1 and Component-2
3. Component-1 carries a weight of 50% and Component -2 carries a weight of 50%
4. Component -1 (CE) is subdivided into Term Tests , Assignments and laboratory examinations/ technical presentation
   Test carry 25 Marks
   Assignment carry 50 Marks.
   Laboratory assessment/ technical presentation carry 25 Marks
   Total 100 marks will be reduced to 50 Marks.
5. Component -2 (SEE) is Written Examination for 100 Marks. It will be reduced to 50 Marks.
6. A minimum of overall 40% is required for a pass with 40% in each of the Components
7. The marks distribution for each course is given in the programme structure-section 20.   Other flexibilities(exceptions) as per the programme regulations

27. **Failure in Course and Makeup Examinations**

Makeup Examinations are provided for the students who are not able to meet all pass criteria prescribed for a module during the regular term and fail in the module.

For further details related to makeup examination, please refer to M.Tech. Programme Academic Regulations document.

28. **Attendance**

Please refer to M.Tech. Programme Academic Regulations document for attendance requirements and condonation related details.

29. **Award of Grades**

As per the M.Tech. Programme Academic Regulations document.

30. **Student Support for Learning**

Students are provided with various facilities to support learning such as the following:
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

31. **Quality Control Measures**

Following are the Quality Control Measures:
1. Review of course notes

2. Review of question papers and assignment questions
3. Student Feedback Analysis
4. Moderation of assessed work
5. Opportunities for the 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 analysis
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

32. Curriculum Map

Module Code	Intended Learning Outcomes											
	Knowledge and Understanding				Cognitive (Thinking) Skills (Critical, Analytical, Problem Solving, Innovation)				Practical Skills			
	KU1	KU2	KU3	KU4	CS1	CS2	CS3	CS4	PS1	PS2	PS3	PS4
19MIC501A	X									X		
19DSC501A	X	X			X	X				X	X	
19DSC502A	X	X				X				X	X	
19MIC502A	X	X				X				X	X	
19MIE501A	X	X				X				X	X	
19FET508A	X	X	X	X								
19FET509A	X	X										
19MIC504A	X	X				X				X	X	
19MIC505A	X	X				X				X	X	
19MIE502A	X	X				X				X	X	
19MIE503A	X	X				X				X	X	
19MIE504A	X	X				X				X	X	
19FET510A	X	X										
19MIC521A	X	X								X	X	
19FET522A	X	X	X	X								
19FET523A	X	X	X	X	X	X	X	X	X	X	X	X
19FET524A					X	X	X	X				
19FET525A	X	X	X	X	X	X	X	X	X	X	X	X
19FET526A					X	X	X	X				
19FET527A	X	X	X	X								
19FET528A	X	X	X	X	X	X	X	X				
19FET529A					X	X	X	X	X	X	X	X
19FET530A					X	X	X	X	X	X	X	X
19MIC522A	X	X	X	X	X	X	X	X	X	X	X	X
19MIC523A	X	X	X	X	X	X	X	X	X	X	X	X

33. Capability / Transferable Skills Map

Module Code	Group work	Self -learning	Research Skills	Written Communication Skills	Verbal Communication Skills	Presentation Skills	Behavioural Skills	Information Management	Personal management/ Leadership Skills
19MIC501A		X		X	X	X		X	
19DSC501A		X	X	X	X	X		X	
19DSC502A		X	X	X	X	X		X	
19MIC502A		X	X	X	X	X		X	
19MIE501A		X	X	X	X	X		X	
19FET508A		X	X	X	X	X		X	
19FET509A		X	X	X	X	X		X	
19MIC504A		X	X	X	X	X		X	
19MIC505A		X	X	X	X	X		X	
19MIE502A		X	X	X	X	X		X	
19MIE503A		X	X	X	X	X		X	
19MIE504A		X	X	X	X	X		X	
19FET510A		X	X	X	X	X	X	X	
19FET521A		X	X	X	X	X		X	X
19FET522A		X	X	X	X	X	X	X	
19FET523A	X	X	X	X	X	X	X	X	
19FET524A		X	X	X	X	X		X	
19FET525A	X	X	X	X	X	X	X	X	
19FET526A	X	X		X	X	X	X	X	X
19FET527A		X	X	X	X	X	X	X	
19FET528A		X		X	X	X	X	X	X
19FET529A	X	X		X	X	X		X	
19FET530A	X	X		X	X	X		X	
19MIC522A	X	X		X	X	X	X	X	X
19MIC523A		X	X	X	X	X	X	X	X

34. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposium, paper writing, attending industry exhibitions, project competitions and related activities to enhance their knowledge and network.

35. Cultural and Literary Activities

To remind and ignite the creative endeavors, annual cultural festivals are held and the students are made to plan and organize the activities.

36. Sports and Athletics

Students are encouraged to develop a habit of taking part in outdoor and indoor games on regular basis.

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