Programme Specifications

M. Tech. Programme

Programme:	Department:
Robotic Engineering	Mechanical and Manufacturing 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 Robotic Engineering	
Faculty	Engineering and Technology
Department	Mechanical and Manufacturing
Programme	Robotic Engineering
Dean of Faculty	Dr. M. Arulanantham
HOD	Dr. T. N. Srikantha Dath

	1.	**Title of the Award**
		M. Tech. in Robotic Engineering
	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**
		May 2019
	7.	**Date of Programme Approval by the Academic Council of MSRUAS**
		August 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
	The applications of robots in various fields is increasing rapidly. Typical application areas include aerospace, automotive, manufacturing, transport and logistics, healthcare, biomedical, defence, agriculture, search and rescue, nuclear facilities, other hazardous environments, servicing and inspection and homes. Industries, developing systems for these sectors need well qualified Robotic Engineers. Manufacturing is growing at a rate of 2.0-2.3% globally and the sector is rapidly adopting Robotic technology for cost effective production to face global competition from lower labour cost countries. Contrary to earlier apprehensions that Robotics would create unemployment, it has now been estimated that each industrial robot needs at least four highly skilled people such as engineers to run, maintain and service it. This is in addition to design, control, manufacturing and programming jobs for engineers that are expected to be created. As a rapidly growing economy India has huge potential to become major player in the area of robotic technologies and systems development. Robotic engineers should be able to conceptualize and design, model, simulate, analyse and validate the robots using modern tools. In order to achieve this, robotic engineers need to be well versed in the areas like geometric modelling of robotic components, mechanisms, kinematics and dynamic analysis of robotic system. In addition they should have complete knowledge of sensors, actuators, drives and control systems, image processing, embedded systems and programming of robots. With the above requirements in view, Robotic engineering is offered as an inter-disciplinary programme by the Department of Mechanical and Manufacturing Engineering. The students are go through various inter-disciplinary areas like kinematics and dynamics, mechatronics, control systems and programming. They are also exposed to different simulation tools to enable them to visualize and develop robotic solutions for a given application. Faculty members from different departments would be offering the modules with customizations and additions for this programme. The graduates would be getting opportunities in manufacturing, healthcare, infrastructure, service sector and other companies; a few of them expected to take up entrepreneurship or research for growth. The faculty of engineering and technology plans for further development of the modules customizing them to the specific requirements of applied robotic engineering and compete with the best universities in the world while attracting high quality graduates as well as teaching talent from all over the country and abroad.

15. Programme Aim

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of contemporary Robotics systems development; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of industry, academics, research or take up entrepreneurial route.

16. Programme Objectives

Students will be taught modelling, programming, simulation, analysis and validation of robotic systems for building robots based applications.

The objectives of the programme are to enable the students to:

1. Discuss the importance of robots in various applications
2. Design, develop geometric models of robots and perform kinematic and dynamic analysis
3. Select sensors, actuators, drives, end effectors and control systems for robots based on application
4. Develop on board real-time decision making capabilities in robots through image and signal processing
5. Design, develop and simulate robotic systems to meet varied functional and operational Requirements
6. Develop a career in Robotics and Automation
7. Practice Teamwork, lifelong learning and continuous improvement

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:	Explain the design and working of robotic systems, principles of sensors and its use in controlling robotic motion
KU2:	Infer robotic system requirement for an application
KU3:	Explain the kinematics and dynamics of robots and their effect
KU4:	Discuss significance of sensors, actuators, end effectors, drives and control systems, image processing algorithms in robot design

2. Cognitive Skills

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

CS1:	Plan and arrive at conceptual configuration of a robot system for a given set of functional requirements
CS2:	Develop an image processing flow diagram and appropriate algorithms for robotic system hardware platform for a specific application
CS3:	Design, model and simulate appropriate control systems for robotic operation
CS4:	Synthesise spatial mechanism for a robot to the defined application

3. Practical Skills

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

PS1:	Create virtual models and analyse robotic systems
PS2:	Use commercially available tools for modelling, simulation and analysis of robot mechanisms and controls
PS3:	Develop program for robotic systems
PS4:	Build robot using subsystems

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.

(Please add course and credit details accordingly : Total 42 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	19MME501A	Computer Aided Design and Engineering	3		2	5	100
2	19RBC501A	Robotic Systems and Applications	4			4	100
3	19RBC502A	Robot Kinematics and Dynamics	3		2	5	100
4	19RBC503A	Mechatronics - 1	3	1		4	100
5	19RBC504A	Mechatronics - 2	3	1		4	100
6	19FET508A	Research Methodology & IPR	2	--	--	2	50
7	19FET509A	Professional Communication	1	--	--	0	
		Total	**19**	**2**	**4**	**24**	**550**
	Total number of contact hours per week	**25 hours**					
	Number of credits can be registered	**Minimum**	**19**		**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	19RBC505A	Control Systems for Robots	3	1		4	100
2	19RBE5X1A	*Refer Elective Module Table*	3	1		4	100
3	19RBE5X2A	*Refer Elective Module Table*	3	1		4	100
4	19RBE5X3A	*Refer Elective Module Table / MOOC*	3	1		4	100
5	19RBE5X4A	*Refer Elective Module Table / MOOC*	3	1		4	100
6	19FET510A	Value Education	1			0	
		Total	**16**	**5**	**X**		**20**
	Total number of contact hours per week	**21 hours**					
	Number of credits can be registered	**Minimum**	**16**		**Maximum**		

SEMESTER 3

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19RBP521A	*Internship*			10	4	100
2	19RBP522A	Group project			**15**	8	200
3	19RBP523A	Dissertation – 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	19RBP523A	Dissertation and Publication – Phase -II			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.	Course Code	Module Title
Stream-1: Robotic System Design	E11	**19RBE511A**	Image Processing for Robotics
	E12	**19RBE512A**	Embedded Systems and programming for Robots
	E13	**19RBE513A**	Machine Learning and Applications
	E14	**19RBE514A**	Robot System Design and Development
Stream-2: Industrial Robotics	E21	**19RBE521A**	Industrial Robotics and Automation
	E22	**19RBE522A**	Computer Vision Systems
	E23	**19RBE523A**	Design of End Effectors
	E24	**19RBE514A**	Robot System Design and Development

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 Course 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**

    a. Every course will be assessed for a weight of 100%

    b. For the courses having 100% theory

    c. There are two components-Component-1 and Component-2

    d. Component-1 (CE) carries a weight of 50% and Component -2 (SEE) carries a weight of 50%

    e. Component-1 (CE): 50% weight

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

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

ILO No.	Intended Learning Outcome	CE (Weightage: 50 %)				SEE (Weightage 50 %)
		Assessment Type	Comp-1a	Comp-1b	Comp-1c	
		Comp Weightage (%)	00	00	00	Sem Exam
1	ILO-1					
2	ILO-2					
3	ILO-3					
4	ILO-4					
5	ILO-5					
6	ILO-6					

CE – can be from any combination of the following:

Assignments, term Tests, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, others, if any.

Component - 2 (SEE): 50% weight

    a. A 3 hour duration Semester End Examination will be conducted for a maximum of 100 marks and will be reduced to 50% weight.

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

    c. For Laboratory/ Practical courses

        a. Total Marks : 50

        b. Component 1(CE) : Laboratory Report: 50% Weight

        c. Component 2(SEE) Semester End Examination: 50% Weight

    d. A 3 hour duration Semester End Examination will be conducted for a maximum of 50 marks.

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

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

ILO No.	Intended Learning Outcome		CE (Weightage: 50 %)	SEE (Weightage 50 %):

		Assessment Type	Conduction of Lab Exercises)	(Viva)	(Lab Record Submission)	(Lab Test)	SEE
		Comp Weightage (%)					50
1	ILO-1						
2	ILO-2						

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

27. Failure in Module 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. Module 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 module 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	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
19MME501A	X	X										
19RBC501A					X				X	X		
19RBC502A	X	X	X		X			X	X	X		
19RBC503A	X	X			X							
19RBC504A	X	X			X		X			X		
19RBC505A	X	X	X	X								
19RBE511A				X		X						
19RBE512A				X		X						
19RBE513A												
19RBE514A	X	X	X	X	X	X	X	X	X	X	X	X
19RBE521A	X	X	X							X		X
19RBE522A	X	X			X	X			X	X	X	
19RBE523A	X	X		X				X				X
19RBP521A	X	X	X	X	X	X	X	X	X	X	X	**X**
19RBP522A	X	X	X	X	X	X	X	X	X	X	X	X
19RBP523A	X	X	X	X	X	X	X	X	X	X	X	X
19FET508A												
19FET509A												
19FET510A												

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
19MMC501A	X	X	X	X	X	X		X	X
19RBC501A	X	X	X	X	X	X		X	X
19RBC502A	X	X	X	X	X	X		X	X
19RBC503A	X	X	X	X	X	X		X	X
19RBC504A	X	X	X	X	X	X		X	X
19RBC505A			X	X	X	X		X	
19RBC505A	X	X	X	X	X	X		X	X
19RBE511A	X	X	X	X	X	X		X	X
19RBE512A	X	X	X	X	X	X		X	X
19RBE513A	X	X	X	X	X	X		X	X
19RBE514A	X	X	X	X	X	X		X	X
19RBE521A		X		X	X	X	X		
19RBE522A	X	X	X	X	X	X		X	X
19RBE523A	X	X	X	X	X	X		X	X
19RBE514A	X	X	X	X	X	X		X	X
19RBP521A		X	X	X	X	X		X	
19RBP522A	X	X	X	X	X	X	X	X	X
19RBP523A		X	X	X	X	X		X	
19FET508A	X	X	X	X	X	X		X	
19FET509A	X	X	X	X	X	X	X	X	
19FET510A				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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