RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF MECHATRONICS ENGINEERING

Minor Degree

CURRICULUM AND SYLLABUS

MINOR DEGREE IN ROBOTICS

RAJALAKSHMI
ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

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DEPARTMENT OF MECHATRONICS ENGINEERING

MINOR DEGREE IN ROBOTICS
Curriculum and Syllabus
REGULATIONS – 2019 Choice Based Credit System
(w.e.f. 2021 Batch onwards)

INSTITUTION VISION:
To be an institution of excellence in Engineering, Technology and Management Education & Research. To provide competent and ethical professionals with a concern for society.

INSTITUTION MISSION
To impart quality technical education imbibed with proficiency and humane values. To provide right ambience and opportunities for the students to develop into creative, talented and globally competent professionals. To promote research and development in technology and management for the benefit of the society.

DEPARTMENT VISION:
To attain excellence in academics, research and technological advancement in Mechatronics Engineering with a concern for society.

DEPARTMENT MISSION:

- To impart high quality professional education and produce Mechatronics Engineers with all round knowledge of multi-disciplinary branches of engineering and technology.
- To foster skill sets required to be a global professional in the areas of automation, intelligent systems, robotics, research for technology management and to fulfill the expectations of industry and needs of the society.
- To inculcate entrepreneurial qualities for creating, developing and managing global engineering ventures.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate

consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Curriculum

Name of the Course		**Robotics**				
Offering Departments		**Mechatronics, and R&A**				
Eligible Departments		**All branches except MCT & RA**				
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1	MT19M11/ MT19M12	Microprocessor & Embedded Systems/ Basic Mechanics	3	0	0	3
2	MT19M13	Introduction to Robotics	3	0	0	3
3	MT19M14	Mechanics of Robots	3	0	0	3
4	MT19M15	Robot dynamics and control	3	0	0	3
5	MT19M16	Programming for Robot Operating System	3	0	0	3
6	MT19M21	Mobile robotics	1	0	4	3
		Total	**16**	**0**	**4**	**18**

Syllabus

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MT19M11	Microprocessor and Embedded Systems		3	0	0	3
Common to	Non- Circuit Branches (Aero, Auto, Biotech, Civil, Chem, Food tech, Mechanical)					

Objectives:
● To understand the architecture and basics of embedded systems
● To understand the architecture and Programming techniques of 8086 microprocessor
● To understand the interfacing process of peripherals with microprocessor
● To understand the peripheral interfacing process of microprocessor
● To understand the peripheral interfacing of microcontroller.

UNIT-I	**Introduction to Embedded Systems**	10
Introduction to Embedded Systems and microcomputers: Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded System Models, Embedded System development cycle, Challenges for Embedded System Design, Evolution of computing systems and applications. Basic Computer architecture: Von-Neumann and Harvard Architecture. Basics on Computer organizations. Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics.		
UNIT-II	**Architecture and Programming of 8086 Microprocessor**	8
Microprocessor: 8086 Microprocessor and its Internal Architecture, Pin Configuration and their functions, Mode of Operation, Introduction to I/O and Memory, Timing Diagrams, Introduction to Interrupts. Introduction to C language, Instruction format, C language programming format, Addressing mode, Instruction Sets, Programming 8086 microprocessor.		
UNIT-III	**Microprocessor Peripheral Interfacing**	9
Microprocessor Interfacing: Introduction to interfacing, Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller, Programmable Key Board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing.		
UNIT-IV	**Architecture and Programming of Microcontroller**	9
. Microcontroller: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, Programming model, addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller		
UNIT-V	**Peripheral Interfacing of Microcontroller and Advanced Embedded Systems**	9
Microcontroller Interfacing: Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor. Introduction to Advanced Embedded Processor and Software: ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C.		
	Total Contact Hours: 45	

Course Outcomes:
● Analyse the internal structure of embedded system
● Develop Microcontroller programs for real time applications
● Develop simple real world applications using microprocessor
● Analyse the architecture and internal components of microcontroller
● Develop programs to interface peripherals with microcontroller.

Text Book(s):
1. K. V. Shibu, Introduction to Embedded Systems, McGRAW Hill Publications (2009).

2. Raj Kamal, Embedded Systems, TATA McGRAW Hill Publications (2003).
3. M. Morris Mano, Computer System Architecture, 3ed, Pearson Publication, (2007).
4. M. Predko, Programming and Customizing the PIC Microcontroller, McGRAW Hill Publications. 3ed, (2017).

Reference Books(s) / Web links:
1. D. V. Hall, 8086 Microprocessors and Interfacings, TATA McGRAW Hill, (2005).
2. B. B. Brey, The Intel Microprocessors, Prentice Hall Publications, 8th ed, (2018).
3. M. A. Mazidi, R.D. Mckinlay and D. Casey, PIC Microcontrollers and Embedded Systems, Pearson Publications, (2008).
4. R. Barnett, L. O'Cull and S. Cox, Embedded C Programming and Microchip PIC, Cengage Learning, (2003).

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CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MT19M11.1	2	0	0	-	2	-	-	-	-	-	-	2
MT19M11.2	2	3	1	-	2	-	-	-	-	-	-	2
MT19M11.3	2	3	1	-	2	-	-	-	-	-	-	2
MT19M11.4	2	3	1	-	2	-	-	-	-	-	-	2
MT19M11.5	2	3	1	-	2	-	-	-	-	-	-	2
Avg	2	3	1	-	2	-	-	-	-	-	-	2

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
MT19M12	**Basic Mechanics**		3	0	0	3
Common to	All Circuit Branches (Bio Med, CSE, CSBS, CSD, ECE, EEE, IT, AIML, AIDS)					

Objectives:

- To learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures.
- To understand the basic components and layout of linkages in the assembly of a system/ machine and also learn about the mechanisms.
- . To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
- To understand the principles in force analysis.
- To learn about the concepts in friction and analyse equilibrium of connected bodies virtual work method.

UNIT-I	**BASICS & STATICS OF PARTICLES**	9
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Equivalent system of forces. Types of supports and their reactions – Plane trusses and frames - Analysis of forces by method of joints and method of sections.		
UNIT-II	**KINEMATIC OF MACHINES**	9
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain kinematics analysis in simple mechanisms – velocity and acceleration polygons - Analytical methods – computer approach.		
UNIT-III	**GEARS AND GEAR TRAINS**	9
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and		

undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains		
UNIT-IV	**FORCE ANALYSIS**	9
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.		
UNIT-V	**FRICTION & VIRTUAL WORK**	9
Sliding and Rolling Friction angle – friction in threads – Friction Drives. Virtual work – Principle of virtual work – System of connected rigid bodies – Degrees of freedom – Conservative forces – Potential energy – Potential energy criteria for equilibrium.		
		Total Contact Hours: 45

Course Outcomes:
● Illustrate the vector and scalar representation of forces and moments
● Recognize the basic terminologies of kinematics and dynamics of machines
● Show the motions parameters on the various mechanisms, gears and gear trains.
● Apply the mechanism, gears and gear train for the design of new machines.
● Interpret the various concepts of kinematics and dynamics including forces and frictions

Text Book(s):
5. Beer, Johnston, Cornwell and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013.
6. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.
7. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.

Reference Books(s) / Web links:
● Rajasekaran S and Sankarasubramanian G, Fundamentals of Engineering Mechanics, 3 rd Edition, Vikas Publishing House Pvt Ltd., India, 2013.
● Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.
● Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.

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CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
MT19M12.1	3	3	2	3	-	-	-	-	-	-	-	1
MT19M12.2	3	3	2	3	-	-	-	-	-	-	-	1
MT19M12.3	3	3	2	3	-	-	-	-	-	-	-	1
MT19M12.4	3	3	2	3	-	-	-	-	-	-	-	1
MT19M12.5	3	3	2	3	-	-	-	-	-	-	-	1
Avg	3	3	2	3	-	-	-	-	-	-	-	1

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MT19M13	Introduction to Robotics		3	0	0	3

Objectives:
• List and explain the basic elements of industrial robots
• Analyse about robot kinematics and various types of sensors used in robotics.
• Explore about the different types of drives and its control methods
• Provide essential programming knowledge in AML, Python, ROS.
• Summarize various industrial and non-industrial applications of robots

UNIT-I	Introduction to robotics	9
Brief History-Definition -Three laws -Robot anatomy-DOF- Misunderstood devices. Classification of Robotic systems- work volume- type of drive. Associated parameters- resolution, accuracy, repeatability, dexterity, compliance, RCC device. Introduction to Principles & Strategies of Automation-Types & Levels of Automations- Need of automation- Industrial applications of robot.		
UNIT-II	**Grippers and Sensors for Robotics**	9
Grippers for Robotics - Types of Grippers- Guidelines for design for robotic gripper- Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics- Classification and applications of sensors- Characteristics of sensing devices- Selections of sensors. Need for sensors and vision system in the working and control of a robot.		
UNIT-III	**Drives and Control for Robotics**	9
Drive - Types of Drives- Types of transmission systems- Actuators and its selection while designing a robot system. Control Systems: Types of Controllers- Introduction to closed loop control.		
UNIT-IV	**Programming and Languages for Robotics**	9
Robot Programming: Methods of robot programming- WAIT, SIGNAL and DELAY commands, subroutines. Programming Languages: Generations of Robotic Languages- Introduction to various types such as VAL, RAIL, AML, Python, ROS. Development of languages since WAVE till ROS.		
UNIT-V	**Related Topics in Robotics**	9
Socio-Economic aspect of robotisation. Economical aspects for robot design- Safety for robot and standards- Introduction to Artificial Intelligence- AI techniques- Need and application of AI- New trends & recent updates in robotics.		
	Total Contact Hours:45	

Course Outcomes:
• To express his views as per terminologies related to Robotics technology.
• To apply logic for selection of robotic sub systems and systems.
• To analyse basics of principals of robot system integration.
• To understand ways to update knowledge in the required area of robotic technology.
• To understand classification of robot actuators in industrial applications.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)

Reference Books(s) / Web links:
1. S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
2. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
3. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

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CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
MT19M13.1	3	-	2	-	-	-	-	-	-	-	-	3
MT19M13.2	3	2	2	2	-	-	-	-	-	-	-	3
MT19M13.3	3	2	2	2	-	-	-	-	-	-	-	3
MT19M13.4	3	2	2	2	3	-	-	-	-	-	-	3
MT19M13.5	3	-	2	-	-	-	-	-	-	-	-	3
Avg	3	2	2	2	3	-	-	-	-	-	-	3

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MT19M14	Mechanics of Robots		3	0	0	3

Objectives:

- This course aims to inculcate thorough understanding about basic knowledge of mathematics, kinematics and dynamics required for understanding motion programming and operational / control functionality in robotics.

UNIT-I	**Mathematical Preliminaries of Robotics**	9
Spatial Descriptions: positions, orientations, and frame, mappings: changing description from frame to frame, Operators: translations, rotations and transformations, transformation arithmetic, compound Transformations, inverting a transform, transform equations, Euler Angles, Fixed Angles, Euler Parameters.		
UNIT-II	**Robot Kinematics**	9
Manipulator Kinematics, Link Description, Link to reference frame connections, Denavit-Hartenberg Approach, D-H Parameters, Position Representations, Homogeneous Transformation Matrix, Forward Kinematics. Inverse Kinematics, Geometric and analytical approach.		
UNIT-III	**Velocities & Statics**	9
Cross Product Operator for kinematics, Jacobians - Direct Differentiation, Basic Jacobian, Jacobian Jv / Jw, Jacobian in a Frame, Jacobian in Frame {0}, Kinematic Singularity, Kinematics redundancy,		
UNIT-IV	**Robot Dynamics Fundamentals**	9
Force balance equation, Forces, Velocity/Force Duality, Virtual Work, Force ellipsoid, Jacobian, Kinematic Singularity, Kinematics redundancy, Mechanical Design of robot linkages,		
UNIT-V	**Robot Dynamics**	9
Introduction to Dynamics, Velocity Kinematics, Acceleration of rigid body, mass distribution Newton's equation, Euler's equation, Iterative Newton –Euler's dynamic formulation, closed dynamic, Lagrangian formulation of manipulator dynamics, dynamic simulation, computational consideration.		
	Total Contact Hours:45	

Course Outcomes:

- To express his views as per terminologies related to Robotics technology.
- To apply logic for selection of robotic sub systems and systems.
- To analyse basics of principals of robot system integration.
- To understand ways to update knowledge in the required area of robotic technology.
- To understand classification of robot actuators in industrial applications.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)

3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)

Reference Books(s) / Web links:

1. S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
2. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
3. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

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MT19M14.1	3	3	2	3	-	-	-	-	-	-	-	3
MT19M14.2	3	3	2	3	-	-	-	-	-	-	-	3
MT19M14.3	3	3	2	3	-	-	-	-	-	-	-	3
MT19M14.4	3	3	2	3	-	-	-	-	-	-	-	3
MT19M14.5	3	3	2	3	-	-	-	-	-	-	-	3
Avg	3	3	2	3	-	-	-	-	-	-	-	3

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MT19M15	ROBOT DYNAMICS AND CONTROL		3	0	0	3

Objectives: The objective of this course is for students to
● Understand the concepts of Rigid motions and Homogeneous Transformations
● To develop the capability of analysing kinematics and dynamics of robotic systems
● Understand the concepts of force control and adaptive control
● Able to learn fundamentals on feedback control systems for robotics
● Able to learn advanced control techniques for robotic systems

UNIT-I	**Basics of Control**	9
Differential Equation, Transfer function, Frequency response, Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design, Bode, polar, Nyquist plot.		
UNIT-II	**Linear Control**	9
Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, P, PI & PID Controller, control law partitioning, modelling and control of a single joint		
UNIT-III	**Non-Linear Control System**	9
Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, the control problems for manipulators.		
UNIT-IV	**Motion Control**	9
Point to Point Control, trajectory generation, Continuous Path Control, Joint based control, Cartesian Control, Force Control, hybrid position/force control system.		
UNIT-V	**Robot Dynamics**	9
The Euler – Lagrange equations, General Expressions for Kinetic and Potential Energy, Equations of Motion, Properties of Robot Dynamic Equations, Newton – Euler Formulation, Planar Elbow Manipulator Revisited.		
Total Contact Hours: 45		

Course Outcomes:
● Develop the control logics using mathematical and graphical methods for robots.
● Design the linear controller for robot dynamics.
● Design the non-linear controller for robot dynamics.
● Analyse the types of motion control in robot dynamics.
● Investigate the robot dynamics under different environmental conditions.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. K. Ogata, “Modern Control Engineering”, Prentice Hall India (2009)
2. M. Spong, M. Vidyasagar, S. Hutchinson, Robot Modeling and Control, Wiley & Sons, (2005)
3. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Dynamics and Control” Wiley India, (2008)

Reference Books(s) / Web links:

1. M. Gopal, Control Systems, McGraw-Hill (2012)
2. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
3. Alok Sinha, “Linear Systems: Optimal and Robust Control”, Taylor & Francis (2007)

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CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MT19M15.1	3	3	2	3	-	-	-	-	-	-	-	2
MT19M15.2	3	3	2	3	-	-	-	-	-	-	-	2
MT19M15.3	3	3	2	3	-	-	-	-	-	-	-	2
MT19M15.4	3	3	2	3	-	-	-	-	-	-	-	2
MT19M15.5	3	3	2	3	-	-	-	-	-	-	-	2
Avg	3	3	2	3	-	-	-	-	-	-	-	2

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MT19M16	Programming for Robot Operating System		3	0	0	3
Common to						

Objectives:
● To handle practical problems arising in the field of engineering and technology using Programming
● To learn the concepts of different types of programming languages
● To impart knowledge on the phenomenon of robot programming knowledge
● To study the basics of ROS and Applications in Industry
● To acquire knowledge in AI

UNIT-I	Introduction	9
Robot Programming Methods, Advantages and Disadvantages of Robot, Requirements for a Robot in an Industry, Specifications of Robot, Operational Capabilities Level of Robot, Modular Robot components, Wrist Mechanism, Numerical Examples		
UNIT-II	**Robot Programming**	9
Methods of Robot Programming, Lead through Programming Methods, A Robot Program as a path in space, Motion Interpolation, Wait, Signal and Delay Commands, Branching, Capabilities and Limitations of Lead through Methods.		
UNIT-III	**Robot Languages**	9
The textual Robot Languages, Generations of Robot Programming Languages, Robot Language structure, Constants, Variables and other Data objects, Motion commands, End effector and Sensor Commands. Computations and Operations, Program control and Subroutines, Communications and Data Processing, Monitor Mode Commands.		
UNIT-IV	**Artificial Intelligence**	9
Introduction, Goals of AI research, AI techniques, LISP Programming, AI and Robotics, LISP in the Factory, Robotic Paradigms		
UNIT-V	**Applications of ROS**	9
The ROS Graph, ROS packages, Service- Define- Implementing Service, Actions- Define, Implement and using, Robots and Simulators- Subsystems, Complete Robots, Moving Around Using ROS- Teleop-bot, Building Maps of the World, Navigating about the World, Chess-bot		
Total Contact Hours: 45		

Course Outcomes:
● Understand Robot Programming and Background
● Analyse different programme of communication with Robot and get familiarized.
● Apply the concept of programming in solving problems
To improve their skills so that they can apply this skill in developing application.
● Familiar with understanding of Applications of ROS.

SUGGESTED ACTIVITIES

- Programming sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. Robotics, Appukuttan, I.K. International Publishing house, Delhi
2. Mikell P, Groover, Industrial Robotics, Tat McGrawHill Education Private Limited, Newdelhi
3. Programming Robots with ROS, Morgan Quigley, Brian Gerkey

Reference Books(s) / Web links:

1. Saha S.K, Introduction to Robotics. Tata McGraw hill Education Pvt Ltd
2. Wyatt Newman A systematic Approach to Learning Robot Programming with ROS
3. John J Craig- Introduction to Robotics, Pearson,2009

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CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MT19M16.1	2	3	2	2	3	-	-	-	-	-	-	2
MT19M16.2	2	3	2	2	3	-	-	-	-	-	-	2
MT19M16.3	2	3	2	2	3	-	-	-	-	-	-	2
MT19M16.4	2	3	2	2	3	-	-	-	-	-	-	2
MT19M16.5	2	3	2	2	3	-	-	-	-	-	-	2
Avg	2	3	2	2	3	-	-	-	-	-	-	2

Subject Code	Subject Name	Category	L	T	P	C
MT19M21	MOBILE ROBOTICS		1	0	4	3
Common to						

Objectives:
To impart knowledge about the basics and constraints in Mobility for Robots
To study about the different sensors integrated with mobile robots
To observe about the Path determination and observance of the Robot environment
To study about the different controlling strategies for Mobile Robots
To expose the different application areas of Mobile Robotics

Description of the Experiments	Total Contact Hours: 75
1. Study of robots history and safety.	
2. Mobile Robot Sensors	
3. Various types of Servo and stepper motor	
4. Inverse Kinematics - Simulator	
5. Direct Kinematics -Simulator	
6. SLAM mapping and Indoor Positioning Robot	
7. Mobile Robot with and without Obstacles	
8. Line Follower Robot using PID algorithm	
9. Colour Sensing Robot with MATLAB	
10. Wireless Gesture-Controlled Robot	
11. Radar and ROS Powered Indoor Home Mapping and Positioning Robot	
12. Fire Fighting Robotic Vehicle	
13. Mini Project-Mobile Robots and IoT	

Course Outcomes:
● Understand the basics of Mobility in Robots along with its constraints
● Compare the sensor performances and able to choose appropriate sensor based upon the requirement
● Perform Localization of Mobile Robot and its Path Planning
● Analyze the performances of different Controllers in Mobile Robots
• Understand the different areas of Applications of Mobile Robots

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic

- Real time hardware demonstration
- Activity Based Learning
- Simulator / open source based software practice
- Application based design task

Text Book(s):
1. Spyros G Tzafestas, “Introduction to Mobile Robot Control”, Elsevier, 2014
2. Gregor Klancar, Andrej Zdesar, Saso Blazic, Igor Skrjanc, “Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems”, Butterworth Heinemann, 2017

Reference Books(s) / Web links:
1. Kevin M. Lynch, Frank C. Park, “Modern Robotics”, Cambridge University Press, 2017
2.Everett H.R., “Sensors for Mobile Robots”, CRC Press, 2010
3.Carlotta A. Berry, “Mobile Robotics for Multidisciplinary Study”, Morgan and Claypool, 2012

S. No	Name of the Equipment	Quantity Required	Remarks
1	Vex EDR kit	15	
2	MATLAB R2022 with Robotics toolbox	35	
3	Vex virtual Reality software	35	
4	VCIMLAB Virtual Reality Robotics Training Software	35	
5	Node MCU with usb cable	25	
6	Arduino Mega 2560 with usb cable	25	
7	Mobile robot(chasis,motor,Battery,all accessories)	25 kit	
8	Gazebo Robot simulator Pro version	25	

SUGGESTED EVALUATION METHODS

- Experiment based viva
- Quizzes
- Mini Project

Web links for virtual lab (if any)
1. www.tinkercad.com
2. https://vlab.amrita.edu/?sub=62&brch=271&sim=1389&cnt=2935

Prepared by Name and signature	Approved by Name and Signature
Mr.V.Kanagaraj	

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MT19M21.1	1	2	3	2	3	-	-	-	2	-	-	2
MT19M21.2	1	2	3	2	3	-	-	-	2	-	-	2
MT19M21.3	1	2	3	2	3	-	-	-	2	-	-	2
MT19M21.4	1	2	3	2	3	-	-	-	2	-	-	2
MT19M21.5	1	2	3	2	3	-	-	-	2	-	-	2
Avg	1	2	3	2	3	-	-	-	2	-	-	2