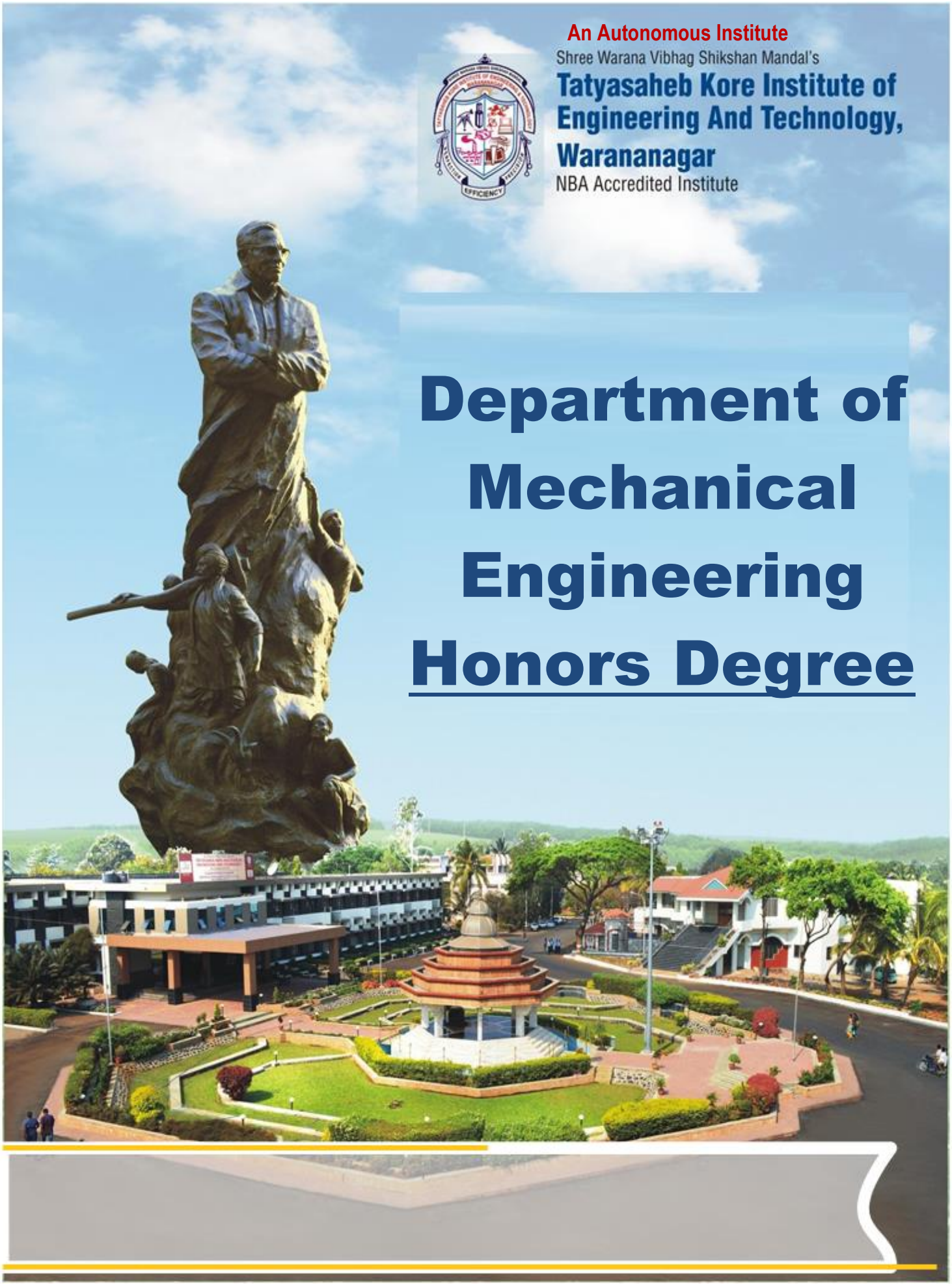
An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute



Department of Mechanical Engineering

Honors Degree

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute
Department of Mechanical Engineering

❖ Vision

To be a leading Mechanical Engineering department recognized for fostering innovation, academic excellence, and ethical professionalism, contributing significantly to industry advancements and societal welfare.

❖ Mission

- Provide a dynamic learning environment that cultivates technical proficiency, critical thinking, and problem-solving skills among students.
- Foster collaboration with industries to ensure curriculum relevance, facilitate internships, and promote entrepreneurial initiatives.
- Promote a culture of research and innovation, encouraging faculty and students to engage in impactful projects addressing contemporary challenges.
- Prioritize inclusivity by providing equal educational opportunities to all students, especially those from rural and underprivileged backgrounds.
- Instil a commitment to lifelong learning, ethical values, and social responsibility, preparing graduates to make meaningful contributions to society and the environment.

Tatyasaheb Kore Institute of engineering and Technology, Warananagar
An Autonomous Institute
Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES

Graduates will be able to,

[1] Graduates will excel in diverse roles within both Indian and multinational corporations, showcasing adaptability and leadership skills.

[2] Graduates will possess advanced technical proficiency, enabling them to innovate solutions for complex mechanical industrial and societal challenges.

[3] Graduates will demonstrate readiness for advanced studies and research endeavors, contributing to the mechanical engineering and scientific community.

[4] Graduates will exhibit a strong commitment to professional integrity and environmental sustainability, integrating ethical considerations into their work practices.

[5] Graduates will proficiently organize multidisciplinary project teams, fostering collaboration and achieving holistic project success.

PROGRAM OUTCOMES

After completion of the Program, graduates will have,

[1] an ability to apply knowledge of mathematics, science, and engineering fundamentals to solve complex engineering problems

[2] an ability to analyse the mechanical problem, interpret data through synthesis and evaluate to make the conclusion

[3] capability to solve complex engineering problems and design system components or processes as per specified requirements addressing public health, safety, cultural, societal, and environmental issues

[4] an ability to identify the problems and apply the research methodology to formulate, investigate and validate the outcomes.

[5] an ability to make use of advanced techniques and tools necessary in engineering practices

[6] an ability to understand societal, health, safety, legal and cultural issues while providing solutions for mechanical engineering problems

[7] an ability to develop sustainable solutions and identify their effects on society and the environment

[8] apply ethical principles and commit to professional ethics and responsibilities of the engineering practice

[9] an ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[10] an ability to comprehend technical ideas, and communicate through effective design documentation and oral presentation.

[11] an ability to lead and manage multidisciplinary teams by applying engineering and management principles.

[12] an ability to engage in independent and lifelong learning in the broadest context of advancement in technology.

PROGRAM SPECIFIC OUTCOMES

[1]Graduates will be able to model and analyze the machine design problems.

[2] Graduates will be able to demonstrate the working of energy conversion devices.

[3]Graduates will be able to manufacture the products using different machine tools.

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Department of Mechanical Engineering

Honors Degree in Robotics and Automation (Mechanical Engineering)

(implemented from 2022-23 Batch)

Credit Scheme

Year and Semester	Course Code	Category	Course Title	Teaching Scheme				Credit Scheme			
				TH	Tut	CH	Total Contact Hours	TH	Tut	CH	Total Credit Assigned
T.Y. B.Tech Sem-V	ME-L-511	PCC	Robotics	3	--	--	3	3	--	--	3
T.Y. B.Tech Sem- VI	ME-L-612	PCC	Kinematics and Dynamics of Robotics	3	--	--	3	3	--	--	3
Final Year Sem-VII	ME-L-710	PCC	Robotics Programming	3	--	--	3	3	--	--	3
Final Year Sem-VII	ME-L-710T	PCC	Robotics Programming Lab	--	--	2	2	--	--	1	1
Final Year Sem-VII	ME-L-711	PCC	Industrial Training	--	--	4	4	--	--	2	2
Final Year Sem-VIII	ME-L-809	PCC	Automation System Design	3	1	--	3	3	1	--	4
Final Year Sem-VIII	ME-L-810	ESC	Industrial Project	--	--	4	4	--	--	4	4
				12	1	10	22	12	1	7	20

Evaluation Scheme

Year and Semester	Course Code	Category	Course Title	Examination Scheme							
				ISE			ESE	TW	O	P	Total
				ISE-I	ISE-II	Avg					
T.Y. B.Tech Sem-V	ME-L-511	PCC	Robotics	40	40	40	60	--	--	--	100
T.Y. B.Tech Sem- VI	ME-L-612	PCC	Kinematics and Dynamics of Robotics	40	40	40	60	--	--	--	100
Final Year Sem-VII	ME-L-710	PCC	Robotics Programming	40	40	40	60	--	--	--	100
Final Year Sem-VII	ME-L-710T	PCC	Robotics Programming Lab	--	--	--	--	25	--	--	25
Final Year Sem-VII	ME-L-711	PCC	Industrial Training	--	--	--	--	25	--	--	25
Final Year Sem-VIII	ME-L-809	PCC	Automation System Design	40	40	40	60	--	--	--	100
Final Year Sem-VIII	ME-L-810	ESC	Industrial Project	--	--	--	--	50	--	--	50
				--	--	160	240	100	--	--	500

BSC: Basic Science Course, **ESC:** Engineering Science Course**, PCC:** Professional Core Course, **OEC:** Open Elective Course**,**

MC: Mandatory Course, **HS:** Humanity Science, **PW:** Project Work (Mini and Major Project), **II:** Industrial Internship

ME511L-ROBOTICS

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**		
Credit	**:**	3	**ISE**	**:**	40 Marks
			ESE	**:**	60 Marks

Course Objectives : The objective of the course is to

1. To acquire basic understanding of robot Fundamentals.
2. To make students understand and learn about Robot Sensors.
3. To make students understand and learn about Robot controls.
4. To acquire knowledge of robot vision,
5. To make students understand and learn about programming languages
6. To acquire knowledge of Futuristic topics in Robotics

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Knowledge of basics of robot Fundamentals	Knowledge Understand
CO2	Knowledge about Robot Sensors	Knowledge
CO3	Knowledge about Robot controls.	Knowledge Understand
CO4	Deeper knowledge of robot vision.	Understand
CO5	Knowledge about programming languages.	Apply Evaluate
CO6	Knowledge of Futuristic topics in Robotics.	Knowledge Understand

Description:

Robotics is the intersection of science, engineering and technology that produces machines, called robots, that substitute for (or replicate) human actions.

Prerequisites:	1	Material Science and Metallurgy
	2	Theory of Machines

Unit 1	**Robot Fundamentals**	
	Definitions, History of robots, present and future trends in robotics, Robot classifications, Robot configurations, Point to Point robots,ContinuousPathrobots,Workvolume,Issuesindesignandcontrollingrobotsrepeatability,Controlresolution,spatial resolution, Precision, Accuracy, Applications of robots. Drives used in robots- Hydraulic, Pneumatic and Electric drives, Comparison of drive systems and their relative merits and demerits.	**6Hrs**
Unit 2	**Robot Sensors:-**	
	Internal and external sensors, position-potentiometric, optical sensors, encoders-absolute, incremental, touch and slip sensors velocity and acceleration sensors, proximity sensors, force &torque sensors, laser range finder, camera. Micro-controllers, DSP, centralized controllers, real time operating systems	**7Hrs**
Unit 3	**Robot Controllers:-**	
	Essential components-Drive for Hydraulic and Pneumatic actuators, H-bridge drives for Dc motor Overload over current and stall detection methods, example of a micro-controller/microprocessor based robot Controller.	**7Hrs**
Unit 4	**Robot Vision:-**	
	Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers, Image processing, low level & high level machine vision systems	**7Hrs**
Unit 5	**Robot Programming languages:-**	
	Introduction the three level of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.	**7Hrs**
Unit 6	**Futuristic topics in Robotics:-**	
	Micro-robotics and MEMS (Micro electro-mechanical systems),fabrication technology for Micro-robotics, stability issue in legged robots, under-actuated manipulators, tele-chairs.	**6Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	1	--	--	--	--	--	---	--	--	--	--	--	--	--
CO2	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--
CO3	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO4	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO6	2	1	1	--	--	--	--	--	--	--	--	--	--	--	--

References:

Text Books	
1	Fu. K. S, Gonzalez. R. C & Lee. C. S. G, "Robotics control, sensing, vision and intelligence", Tata- Mc Graw Hill Pub. Co., 2008
2	Klafter. R. D, Chmielewski. T. A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice Hall of India Pvt. Ltd., 1994.
Reference Books	
1	S. R. Deb, –Robotics Technology and Flexible Automation–, Tata McGraw Hill1994
2	Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008
3	J. J. Craig, introduction to Robotics, Addision-Wesely 1989.

ME612L-KINEMATICS AND DYNAMICS OF ROBOTICS

Lectures	**:** 3 Hrs/Week	**Evaluation Scheme**	
Credit	**:** 3	**ISE**	**:** 40 Marks
		ESE	**:** 60 Marks

Course Objectives: The objective of the course is to

Provides an overview of kinematics, dynamics, and basic control for robotic mechanism. Provide the fundamental knowledge and tools needed for modelling, design, planning, and control of robot systems.

Course Outcomes:

COs	At the end of successful completion of the course ,the student will be able to	Blooms Taxonomy
CO1	Understand concept of configuration space and rigid body motions	Knowledge Understand
CO2	Calculate configuration of the hand of the robot based on joint values	Knowledge Understand
CO3	Grasp efficient numerical algorithms for forward dynamics and inverse dynamics	Knowledge Understand
CO4	Plan a motion for a robot in the presence of obstacles	Understand Apply
CO5	Analyse and plan robot grasping and other manipulation tasks	Apply Analyze
CO6	Identify and propose a solution for real world problem	Create

Description:

This course is offered as part of honors degree in robotics and automation. This course contains overview of kinematics, dynamics, and basic control for robotic mechanism. The students are expected to complete this course through online platform such as Coursera or SWAYAM.

Prerequisites:	1:	Matrix algebra and differential equations
	2:	Familiarity with numerical platform like MATLAB or Python

Unit 1	**Introduction to Modern Robotics**	
	Introduction to Modern Robotics, Configuration space and degrees of freedom of rigid bodies and robots, configuration and velocity constraints; task space and workspace, Rigid-body motions.	**6 Hrs**
Unit 2	**Robot Kinematics**	
	Forward Kinematics, Velocity Kinematics and Statics, Inverse Kinematics, Kinematics of Closed Chains	**6 Hrs**
Unit 3	**Robot Dynamics**	
	Dynamics of Open Chains, Forward dynamics of an open chain, task-space dynamics, constrained dynamics, Trajectory Generation.	**6 Hrs**
Unit 4	**Planning and Control of Robot Motion**	

	Motion planning, First- and second-order linear error dynamics, stability of a feedback control system, and motion control of robots when the output of the controller commands joint velocities, Motion control of robots when the output of the controller commands joint torques, force control, and hybrid motion-force control.	**6 Hrs**
Unit 5	**Robot Manipulation**	
	Grasping and Manipulation, Kinematics of contact, contact types, graphical methods for representing kinematic constraints in the plane, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, Wheeled Mobile Robots.	**6 Hrs**
Unit 6	**Course Project**	
	This project is a group activity where students are expected to work on real world problems and find an innovative solution. For this project students should apply knowledge from above units.	**10 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	1	--	--	---	--	--	---	--	--	--	--	--	--	--
CO2	3	1	--	--	1	--	--	--	--	--	--	--	--	--	--
CO3	3	1	1	--	1	--	--	--	--	--	--	--	--	--	--
CO4	3	2	2	1	1	--	--	--	--	--	--	--	--	--	--
CO5	3	2	2	1	1	--	--	--	--	--	--	--	--	--	--
CO6	--	3	3	2	2	--	--	--	2	--	--	--	--	--	--

References:

Reference Books	
1	Fundamentals of Robotics by D.K. Pratihar, Narosa Publishing House, New-Delhi, 2017
2	Introduction to Robotics by J.J. Craig, Addison-Wesley Publishing Company, 1986
3	Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book co, 1987.
4	Modern Robotics: Mechanics, Planning, and Control" (Lynch and Park, Cambridge University Press 2017)

Web Links for online courses

Coursera:- https://www.coursera.org/learn/modernrobotics-course1

Swayam:- https://onlinecourses.nptel.ac.in/noc19_me74/preview

ME710L-ROBOTICS PROGRAMMING

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**
Credit	**:**	3	**ISE** **:** 40 Marks
			ESE **:** 60 Marks

Course Objectives: The objective of the course is to
To enlighten the students about the use of robot programming for various applications.

Course Outcomes:

COs	**At the end of successful completion of the course ,the student will be able to**	**Blooms Taxonomy**
CO1	Basics of Robot programming	Knowledge Understand
CO2	VAL language applications	Knowledge
CO3	RAPID language applications	Knowledge and Apply
CO4	Practical study of virtual robot software	Knowledge and Create
CO5	VAL-II and AML language	Understand

Description:

Robotics Programming course is offered as the Program elective course. This course contains construction and working of robots and its parts by using various programming software. This course has five units namely i) Basics of Robot Programming, ii) VAL Language iii) Rapid Language, iv) VAL-II and AML, v) Practical Study of Virtual Robot

Prerequisites:	1:	Robotics and Automation
	2:	CIM
	3:	Industrial Fluid Power

Unit 1	**Basics of Robot Programming**	
	Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands-Operating mode of robot, JoggingTypes, Robot specifications- Motion commands, end effectors and sensors commands.	**8Hrs**
Unit 2	**VAL Language**	
	Robot Languages-Classifications, Structures- VAL language commands- motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications.	**8Hrs**
Unit 3	**Rapid Language**	
	RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Move master command language-Introduction, syntax, simple problems	**8Hrs**

Unit 4	**VAL-II and AML**	
	VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor commands-Data processing.	**8Hrs**
Unit5	**Practical Study of Virtual Robot**	
	Robot cycle time analysis-Multiple robot and machine Interference-Process chart Simple problems-Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning, program modules, input and output signals-Singularities Collision detection-Repeatability measurement of robot-Robot economic	**8Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	1	--	---	--	--	---	--	--	--	--	--	--	--
CO2	2	--	--	--	3	--	--	--	--	--	--	--	--	--	--
CO3	2	--	2	--	--	--	--	--	--	--	--	--	--	--	--
CO4	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	3	--	--	--	--	--	--	--	--	--	--	--	--

References:

	Reference Books
1	Deb. S. R. "Robotics Technology and Flexible Automation", Tata McGraw Hill publishing company limited, 1994
2	Mikell. P. Groover, "Industrial Robotics Technology", Programming and Applications, McGraw Hill Co, 1995.
3	Klafter. R.D, Chmielewski.T.A and Noggin's, "Robot Engineering : An Integrated Approach", Prentice Hall of India Pvt. Ltd.,1994.
4	Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book co, 1987.
5	Craig .J. J, "Introduction to Robotics Mechanics and Control", Addison- Wesley, 1999.
6	Robotics Lab manual, 2007.

Web Links/ Video Lectures
Lectures 1. https://nptel.ac.in/courses/112105249

ME710T-ROBOTICS PROGRAMMING LAB

Lectures	**:**	----	**Evaluation Scheme**		
Credit	**:**	1	**ISE**	**:**	----
Practical	**:**	2 Hr/Week	**ESE**	**:**	----
			ISA	**:**	25 Marks

Course Objectives: The objective of the course is to

To enlighten the students about the use of robot programming for various applications.

Course Outcomes:

COs	At the end of successful completion of the course ,the student will be able to	Blooms Taxonomy
CO1	Acquired knowledge and understanding of the fundamentals of robot programming.	Knowledge Understand
CO2	Gain knowledge in the application of the VAL language for robots	Knowledge
CO3	Possess knowledge of RAPID language applications but will also be able to apply this knowledge effectively	Knowledge and Apply
CO4	To acquire knowledge and the capability to create and work with virtual robot software in practical scenarios.	Knowledge and Create

Description:

The Robotics Programming Lab is where students get hands-on experience with real robots. It goes along with what they learn in class. The lab covers the same five modules, focusing on practical work. This helps students grasp the ideas and apply them in real situations, improving their robotics skills.

Prerequisites:	1:	Robotics and Automation
	2:	CIM
	3:	Industrial Fluid Power

Experiment Set 1	**Basics of Robot Programming**	
	Coordinate System Analysis: Program the robot to perform tasks using various coordinate systems and analyze the effects of these systems on robot movements. **End Effector Integration:** Connect and configure different end effectors and sensors on the robot, then implement tasks using these components. **Interpolation Techniques:** Experiment with interpolation commands to observe how they affect the robot's path and precision in executing tasks.	**8Hrs**
Experiment Set 2	**VAL Language**	
	Pick and Place Application: Develop a program using VAL language commands for a pick and place application and evaluate its efficiency and accuracy. **Palletizing Simulation:** Program the robot for palletizing tasks using VAL language and assess its performance in handling palletization. **Effective Communication:** Implement and test WAIT, SIGNAL, and DELAY commands	**8Hrs**

	for communication in a simple application and evaluate their reliability.	
Experiment Set 3	**Rapid Language**	
	Basic RAPID Commands: Practice using fundamental RAPID commands for controlling robot movements and tasks. **Motion Instructions in RAPID:** Implement different motion instructions in RAPID and assess their impact on the robot's actions. **Subroutine-Based Programming:** Create programs using subroutine-based programming in RAPID to optimize and simplify robot tasks.	**8Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	--	1	--	---	--	--	---	--	--	--	--	--	--	--
CO2	2	--	--	--	3	--	--	--	--	--	--	--	--	--	--
CO3	2	--	2	--	--	--	--	--	--	--	--	--	--	--	--
CO4	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	3	--	--	--	--	--	--	--	--	--	--	--	--

References:

	Reference Books
1	Deb. S. R. “Robotics Technology and Flexible Automation”, Tata McGraw Hill publishing company limited, 1994
2	Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.
3	Klafter. R.D, Chmielowski T. A. and Noggin’s, “Robot Engineering : An Integrated Approach”, Prentice Hall of India Pvt. Ltd.,1994.
4	Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book co, 1987.
5	Craig .J. J, “Introduction to Robotics Mechanics and Control”, Addison- Wesley, 1999.
6	Robotics Lab manual, 2007.

Web Links/ Video Lectures
Lectures 1. https://nptel.ac.in/courses/112105249

ME711T – INDUSTRIAL TRAINING

Lectures	**:**	----	**Evaluation Scheme**		
Credit	**:**	2	**ISE**	**:**	----
Training	**:**	4 Hr/Week	**ESE**	**:**	----
			ISA	**:**	50 Marks

Course Objectives: The objectives of the course are:

- To familiarize the students with the work culture in robotic industry.
- To provide students with opportunities for practical and hands-on training from industrial fraternity working in robotics area.
- To expose students to a work environment, common practices, employment opportunities and work ethics in robotics industry.

Course Outcomes:

COs	At the end of successful completion of the course, the student will be able to	Blooms Taxonomy
CO1	Comprehend and correlate the knowledge gained from courses in honors degree.	Understand
CO2	Learn to implement appropriate techniques, resources, and robotic engineering tools.	Apply
CO3	Develop the capability to work in team.	Apply
CO4	Write detailed technical report.	Apply and Analyze

Description:

The students must undergo an industrial training of minimum two weeks in an industry preferably involved design of robots and automated systems or utilizing robots for any applications during the semester break after sixth semester. Students can complete this training within minimum 15 calendar days before the start of seventh semester. The students must submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

It is expected that students should undertake small assignment or work related to any of the honors degree courses. Report should be based on design of robots, application of robots for completing different tasks, programming of robots or the design of the entire automation system.

Industrial Training Report Format	Maximum five students in one group, can undergo training in same industry. The same group shall work together for industrial project. However, each student should have different task or assignment during the training. The report should be of 20 to 25 pages. For standardization of the report the following format should be strictly followed. 1. Page Size: Trimmed A4 2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.32 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Pt. font 7. Line Spacing: 1.5 lines 8. Page Numbers: Right aligned at footer. Font 12 Pt. Times New Roman 9. Headings: New Times Roman, 14 Pt., Bold face 10. Certificate: All students should attach standard format of Certificate as prescribed by the department. Certificate should be awarded preferably to batch and not for individual student. However, certificate for individuals in exceptional cases with permission of concern guide will be considered. It should have signatures of Guide, Head of Department and Principal.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

ME809L-Automation System Design

Lectures	**:**	3 Hrs/Week	**Evaluation Scheme**	
Credit	**:**	3	**ISE**	**:** 40 Marks
			ESE	**:** 60 Marks

Course Objectives : The objective of the course is to

- To understand the basic concepts of Automation.
- To study automated flow lines with buffer storage and method of Work-part Transport.
- To learn Types of Material Handling Equipment, Analysis for Material Handling Systems.
- To know Automated Inspection and Testing Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods.
- To provide knowledge about Industrial control systems, process industries versus discrete manufacturing industries.
- To study Introduction of PLC, Micro PLC, Programming a PLC, Logic Functions.

Course Outcomes:

COs	At the end of successful completion of the course ,the student will be able to	Blooms Taxonomy
CO1	Understand the need of automation	Knowledge Understand
CO2	Classify various types of automated transmission lines and components of automation.	Understand
CO3	List and understand various material handling systems.	understand Apply
CO4	Design various types of automated assembly systems	Apply
CO5	Explain various automatic inspection systems	Understand Apply
CO6	Develop simple automation programs using PLCs	Understand Apply

Description:

An automation system is an integration of sensors, controls, and actuators designed to perform a function with minimal or no human intervention. The field concerned in this subject is called Mechatronics which is an interdisciplinary branch of engineering that combines mechanical, electrical, and electronic systems.

Prerequisites:	1:	Computer Integrated Manufacturing
	2:	Robotics
	3:	Mechatronics

Unit 1	**Introduction** Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break- Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in process.	**6Hrs**
	Detroit-Type Automation	

Unit 2	Automated Flow lines, Methods of Work-part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations, Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines.	**7 Hrs**
Unit 3	**Material handling and Identification Technologies**	
	The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc. Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine.	**7Hrs**
Unit 4	**Automated Inspection and Testing**	
	Automated Inspection and Testing Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.	**6Hrs**
Unit 5	**Control Technologies in Automation:**	
	Industrial control systems, process industries verses discrete manufacturing industries, continuous verses discrete control, computer process Control and its Forms. Computer Based Industrial Control: Introduction & automatic process control, building blocks of automation system: LAN, analog & digital I/O modules, SCADA system & RTU. automated inspection and testing: Inspection and testing, statistical quality control.	**7Hrs**
Unit 6	**Programmable Logic Controllers (PLCs)**	
	Introduction, Micro PLC, Programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Documenting a PLC System, Timer & Counter Instructions, Comparison & Data Handling Instructions, Sequencing Instructions, Mask Data Representation, Typical PLC Programming Exercises for Industrial Applications.	**7 Hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	1	2	1	3	2	--	---	--	--	--	--	--	--	--
CO2	2	2	2	2	2	--	--	--	--	--	--	--	--	--	--
CO3	3	2	2	--	3	2	1	--	--	--	--	--	--	--	--
CO4	2	2	2	2	2	--	--	--	--	--	--	--	--	--	--
CO5	2	2	2	2	3	2	1	--	--	--	--	--	--	--	--
CO6	2	2	2	--	2	2	--	--	--	--	--	--	--	--	--

References:

Text Books

1	Automation, Production systems and Computer Integrated Manufacturing, 3/e - M. P. Groover (PHI or Pearson Education)
2	Radhakrishnan P, Subramanian S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
Reference Books	
1	"Computer Based Industrial Control" – Krishna Kant, EEE-PHI
2	Principles and Applications of PLC – Webb John, McMillan 1992
3	"An Introduction to Automated Process Planning Systems" – Tiess Chiu Chang & Richard A. Wysk
4	"Anatomy of Automation" – Amber G.H & P.S. Amber, Prentice Hall.

Web Links/ Video Lectures

Lectures **1.https://nptel.ac.in/courses/112102011**

2. https://nptel.ac.in/courses/108105088

ME810L INDUSTRIAL PROJECT

Practical	**:**	2 hrs/week	**Evaluation Scheme**		
Credit	**:**	4	**ISE**	**:**	----
Training	**:**	4 Hr/Week	**TW**	**:**	50 Marks
			POE	**:**	50 Marks

Course Objectives: The objective of the course is to

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently to come with the solution for real life robotics and automation related problems.
2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions, and decision-making process.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Think creatively on real life robotic engineering problem.	Knowledge, Understand,
CO2	Use robotics and automation knowledge to deduce proper solution to real life engineering problems.	Knowledge, Understand, Application
CO3	Work in a team and acquire collaborative skills to achieve common goals.	Knowledge, Understand, Application
CO4	Learn independently, reflect on their learning, and take appropriate actions to improve it.	Knowledge, Understand, Application, Synthesis
CO5	Communicate effectively and present ideas clearly with specific audience in written and oral forms.	Knowledge, Understand, Application, Synthesis
CO6	Plan for activities in order to complete the task in predefined time.	Knowledge, Understand, Application, Create

Description:

The project work phase I can be a design project / experimental project and or computer simulation project or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students' groups are required to undertake the project Phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe. The project phase I work is to be extended for project phase II at B. Tech. (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Prerequisites:	1:	Fundamentals of Mechanical Engineering
	2:	Report writing and Presentations Skills
	3:	Basic Communication skills

Industrial Project Workload:

A groups of four to five students per group, shall work under one Faculty member of the department. The group of one student is strictly not allowed.

Industrial Project Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for following contents:

a) Searching suitable project work
b) Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
c) Day to day activities carried out related to project work for entire semester.

2. Synopsis: Project synopsis including i. Title of Project ii. Names of Students iii. Name of Guide iv. Relevance v. Present Theory and Practices vi. Proposed work vii. Expenditure viii. References should be submitted. The synopsis shall be signed by each student in the group, approved by the guide and endorsed by the Head of the Department.

3. Industrial Project Report Format:

Project report should be typed on A4 size sheets. For standardization of the project reports the following format should be strictly followed.

a) Top Margin: 1.00 Inch
b) Bottom Margin: 1.32 Inches
c) Left Margin: 1.5 Inches
d) Right Margin: 1.0 Inch
e) Para Text: Times New Roman 12 Pt. font
f) Line Spacing: 1.5 lines
g) Page Numbers: Right aligned at footer. Font 12 Pt. Times New Roman
h) Headings: New Times Roman, 14 Pt., Bold face
i) References: References should have the following format
    I. For Books: “Title of Book”, Authors, Publisher, Edition
    II. For Papers: “Title of Paper, Authors, Conference Details, Year

4. Industrial Project Report Content:

The Project report shall be signed by each student in the group, approved by the guide and endorsed by the Head of the Department. For standardization of the project reports, it should include following contents.

a) Title Sheet
b) Certificate
c) Acknowledgement
d) Table of Contents.
e) List of Figures
f) Body of Report
    I. Introduction
    II. Literature Survey/Theory
    III. Problem definition and objectives
    IV. Methodology containing Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation.
    V. Discussion on Result and Conclusion
g) References: References should have the following format For Books: “Title of Book”, Authors, Publisher, Edition for Papers: “Title of Paper, Authors, Journal/Conference Details, Year

5. Presentation: The group must present their project in front of the faculty members of the department at the end of semester.

Term Work (TW):

Department will constitute an Evaluation Committee to review the industrial project work. The evaluation committee consists of faculty members of which internal guide and another expert in the specified area of the project. The completion of work, the submission of the report and assessment should be done at the end of the semester.

Mark Distribution:

Concept – 10 Marks, Work Done –20 Marks, Presentation – 10 Marks, Report – 10 Marks

Practical Oral Examination (POE):

Oral examination shall be conducted with presentation of an industrial project.

The distribution of marks shall be

- 10 marks for contribution of the student in the project work
- 20 marks shall be awarded for achieving the objectives of the project set forth.
- 20 marks for Question/ Answer

*The external examiner shall be preferably an Industrial expert from the same field.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1															
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CO4															
CO5															
CO6															