

## Industrial Manufacturing Technician Hybrid Bootcamp

Module	Description	Potential Laboratory	Mathematics Objectives	Industrial Maintenance Objectives	Industrial Maintenance Laboratory Objectives
<p><b>MODULE 1</b> Introduction to Industrial Maintenance Careers and Basic Mathematics for Engineering</p>	<p>In this unit, students are introduced to the breadth of career opportunities within Industrial Maintenance, paving the way for their future employment search using tools like Indeed and the Quast HVCC Apprenticeship Program. The unit starts with an assessment of mathematical competencies followed by a series of mathematical problems necessary for the field. This includes starting with basic math principles, such as positional value, addition, and subtraction, followed by multiplication, division, and their applications. Problems 1 further extends to more complex mathematical concepts like order of operations and their application problems. Integral skills in working with fractions and conducting unit conversions, including but not limited to inches to feet, yards to miles, are developed. Furthermore, the students are familiarized with engineering units such as milli, micro, nano, kilo, mega, giga, peta, etc. Overall, this unit is designed to equip students with both a firm understanding of the career landscape in industrial maintenance and the foundational mathematical competencies that are critical in this field.</p>	<p>Basic Math and Unit Conversion Workshop: In this activity, students will be given a set of real-world industrial maintenance scenarios that require the application of basic mathematical operations and unit conversions. The students would need to apply their knowledge of fractions and unit conversions to solve these problems. For example, they could be given a task to calculate the length of a machine component in different units (inches, feet, yards, miles) or calculate the power of an electrical component given its resistance and current using the engineering units they've learned.</p> <p>Interactive Career Path Exploration: Students will research different careers in industrial maintenance, focusing on job responsibilities, required skills, and potential employers. Using this information, they will create a career path diagram that includes the necessary steps to reach their desired job. They will then present their roadmaps to the class, facilitating discussions on various career opportunities in the field.</p> <p>Engineering Unit Bingo: In this game-based learning activity, each student is given a bingo card with different engineering units (milli, micro, nano, kilo, mega, giga, peta). The instructor calls out various objects or quantities with a specific measurement (e.g., the weight of an average can, the memory capacity of a typical computer), and the students need to identify the correct engineering unit. This activity helps reinforce the understanding of different engineering units in a fun and interactive way.</p>	<p><b>Application Level:</b> Use basic mathematical concepts to practical problems in industrial maintenance, such as calculations of measurements, dimensions, and unit conversions, using appropriate calculation tools and techniques.</p> <p><b>Objective:</b> Utilize basic mathematical operations, such as addition, subtraction, multiplication, and division, to solve industrial maintenance problems, including component dimension calculations and unit conversions.</p> <p><b>Application Level:</b> 1) Application: Solve using the mathematical formulas and concepts in the module to calculate and solve practical problems in industrial maintenance, such as determining the velocity of a machine or calculating the electrical resistance of a component. 2) Problem solving: Apply the mathematical principles and techniques learned in the module to address and solve real-world problems in industrial maintenance, such as determining the force required to lift an object or calculating the amount of material needed for a construction. 3) Technical skills practice: Using the mathematical knowledge in solving specific technical tasks in industrial maintenance, such as calculating the length of a cable required for an electrical installation or determining the dimensions of a mechanical part.</p>	<p><b>Analysis Level:</b> Analyze industrial maintenance problems involving mathematical concepts and apply problem-solving strategies to identify key variables, break down problems into smaller components, and understand the relationships between them.</p> <p><b>Objective:</b> Decompose industrial maintenance problems related to mathematical concepts, such as positional values, mathematical operations, and unit conversions, to identify key elements and analyze the relationships between them in order to efficiently solve the problems.</p> <p>1) Problem decomposition: Analyze industrial maintenance problems involving mathematical concepts, such as positional values, mathematical operations, and unit conversions, to identify key elements and analyze the relationships between them. 2) Data interpretation: Analyze and evaluate technical data and results collected in the context of industrial maintenance, identifying trends, patterns, or significant mathematical relationships to solve problems and make informed decisions. 3) Evaluation of solutions: Critically evaluate proposed solutions for industrial maintenance problems, analyzing their validity, effectiveness, and efficiency based on relevant mathematical and technical principles, and propose improvements or alternatives when necessary.</p>	<p><b>Evaluation Level:</b> Evaluate and select the best mathematical strategies and techniques to solve industrial maintenance problems, considering accuracy, efficiency, and the practical implications of proposed solutions.</p> <p><b>Objective:</b> Evaluate different mathematical strategies and techniques to solve complex industrial maintenance problems, considering effectiveness, efficiency, and the practical applicability of proposed solutions. Select and justify the most appropriate strategy to solve specific problems based on established criteria.</p> <p>1) Assess and compare various mathematical strategies for solving industrial maintenance problems, considering their effectiveness, efficiency, and practicality in relation to specific problem criteria. 2) Choose and provide a rationale for selecting the most appropriate mathematical strategy to solve specific industrial maintenance problems, based on established criteria and considering factors such as accuracy, cost-effectiveness, time efficiency, and available resources. 3) Assess the practical implications of proposed mathematical solutions for industrial maintenance problems, taking into account factors such as technical feasibility, practical implementation, and impact on operational efficiency.</p>
<p><b>MODULE 2</b> Precision Measurement and Occupational Safety Personal Protective Equipment and Compliance</p>	<p>This unit marries the practical application of precision measurement with the fundamental knowledge of industrial safety and the use of Personal Protective Equipment (PPE). Precision measurement techniques are introduced from the outset, with focus placed on understanding measurements as precise as 0.001" and 0.01mm. Students are taught to comprehend measurements expressed in thousands of an inch, such as "0.001" and 0.01mm, and to recognize measurements like 1/16" in decimal form. This is facilitated through hands-on practice with tools like the machinist's rule (0, 10, 16, 32, 50, 64 increments), micrometers in both metric and U.S. standard versions (base, sleeve, thimble, vernier), and calipers (Digital, Dial, Vernier) with a precision threshold of 0.004".</p> <p>This technical acuity is further supported by a recap of critical mathematical principles such as understanding division as multiplying by the reciprocal, and determining the least common denominator for adding fractions.</p> <p>The latter part of the unit transitions into the study of industrial safety, exploring the types of PPE and their application in the workplace to prevent electrical and other hazards. The significance of adhering to OSHA regulations is emphasized, along with the effective use of lockout/tagout techniques and the safe handling of manual and electrical tools. Theoretical instruction is combined with practical exercises to provide students with a comprehensive understanding of these topics. Ultimately, this unit aims to instill safe and efficient work practices in a mechatronics context through the application of these learned skills and knowledge.</p>	<p>Precision Measurement Station: Set up rotation stations where students can get hands-on practice with the precision measurement tools outlined in the unit such as the machinist's rule, micrometers, and calipers. This activity will help students understand the importance of accuracy in industrial processes and familiarize them with the different measuring tools.</p> <p>Mathematics Refresher Workshop: Conduct a practical workshop where students solve problems involving division as multiplying by the reciprocal, and determining the least common denominator for adding fractions. This will help reinforce the mathematical principles critical to precision measurement and other mechatronics applications.</p> <p>Lockout/Tagout (LOTO) Simulation: Create a safe simulation of an industrial environment where students can practice applying lockout/tagout procedures. This will help them understand the reasoning behind LOTO procedures and learn to define and achieve a "zero energy" state in a hands-on, practical context. Ensure students adhere to OSHA regulations during the simulation to promote safe work practices.</p>	<p><b>Application Level:</b> Employ learned mathematical principles to perform precision measurements in the context of mechatronics using appropriate measurement tools and precise techniques to achieve measurements with an accuracy of up to 0.001" and 0.01mm.</p> <p><b>Analysis Level:</b> Analyze and solve mathematical problems related to precision measurements in mechatronics, such as converting measurements between different units (e.g., inches and millimeters) and understanding and utilizing measurement scales in tools such as micrometers, vernier calipers, and calipers.</p> <p><b>Evaluation Level:</b> Evaluate the accuracy and precision of measurements conducted in the mechatronics laboratory, comparing them to established measurement standards and using appropriate verification and validation techniques.</p>	<p><b>Application Level:</b> Apply mechatronics concepts and principles to design, build, and test mechatronic systems and devices, using technical knowledge and practical skills to integrate mechanical, electrical, and control components.</p> <p><b>Analysis Level:</b> Investigate and evaluate existing mechatronic systems, breaking down their components and understanding the interactions between them, in order to identify potential improvements, solve problems, and optimize system performance.</p> <p><b>Evaluation Level:</b> Evaluate the effectiveness and performance of mechatronic systems and their components through appropriate testing and analysis methods to measure and compare variables such as speed, accuracy, power consumption, and safety.</p>	<p><b>Application Level:</b> Apply appropriate laboratory techniques and procedures to perform precision measurements, calibrate instruments, and equipment, and conduct tests and experiments related to mechatronics, following established safety standards and protocols.</p> <p><b>Analysis Level:</b> Examine and evaluate the data and results obtained in the laboratory, identifying patterns, trends, and significant relationships, and utilizing statistical tools and analysis techniques to interpret the results and draw conclusions.</p> <p><b>Evaluation Level:</b> Measure the validity and reliability of the data and results obtained in the laboratory, using appropriate verification and validation techniques, and comparing the results to established standards and specifications.</p>
<p><b>MODULE 3</b> Lockout/Tagout (LOTO) Techniques: Implementation, Certification, and Workplace Safety</p>	<p>This unit provides a detailed exploration of Lockout/Tagout (LOTO) techniques and their critical role in promoting industrial safety. Students will understand the reasoning behind LOTO procedures and learn to define and achieve "zero energy" state. The unit also involves a LOTO Certification Session, which forms a cornerstone in OSHA's training requirements. Understanding of hazardous materials and respirator usage will also be covered, providing students a comprehensive view of safety measures. This learning will prepare students to manage electrical and other risks effectively in the workplace, aligning with OSHA standards and ensuring safe practices in mechatronics and manufacturing environments.</p>	<p>LOTO Application on Mechatronics Equipment: In this practical exercise, students can apply LOTO procedures on real or simulated mechatronics equipment. The goal is to safely achieve a "zero energy" state, which is particularly critical in mechatronics where multiple types of energy (electrical, pneumatic, hydraulic) may be present.</p> <p>Hazardous Material Handling in a Mechatronics Context: Students can engage in a simulated activity dealing with materials commonly found in mechatronics environments. They could practice procedures for safe handling, storage, and disposal of these materials, following OSHA guidelines. They could also learn how to select and use appropriate PPE, including respirators, in response to different types of hazardous materials.</p> <p>Mechatronics Equipment Audit for OSHA Compliance: This practical exercise involves students conducting a safety audit of a mechatronics workstation or laboratory. They would identify potential safety risks or non-compliance with OSHA regulations, focusing on LOTO procedures, hazardous material handling, and proper respirator usage. Afterward, they can recommend improvements to achieve better compliance and enhance safety.</p>	<p><b>Application Level:</b> Use mathematical principles to calculate and evaluate tolerances and critical dimensions in Lockout/Tagout (LOTO) procedures in mechatronic environments, ensuring the necessary accuracy to guarantee safety and process efficiency.</p> <p><b>Analysis Level:</b> Analyze and evaluate problems and situations in Lockout/Tagout (LOTO) procedures using mathematical methods, such as risk analysis and probability assessment, to identify and mitigate potential hazards and risks in mechatronic environments.</p> <p><b>Evaluation Level:</b> Evaluate and compare different mathematical strategies and techniques used in Lockout/Tagout (LOTO) procedures, considering factors such as effectiveness, efficiency, and safety, and select the best options to ensure proper lockout/tagout in mechatronic environments.</p>	<p><b>Application Level:</b> Employ mechatronics knowledge and Lockout/Tagout (LOTO) procedures to design and implement safe systems that comply with industrial safety standards and OSHA regulations in mechatronic environments.</p> <p><b>Analysis Level:</b> Analyze and evaluate existing mechatronic systems in terms of safety and apply Lockout/Tagout (LOTO) techniques to identify and address risks and hazards related to mechanical, electrical, and control components.</p> <p><b>Evaluation Level:</b> Evaluate and monitor the effectiveness of Lockout/Tagout (LOTO) procedures in mechatronic environments, ensuring compliance with safety standards and ensuring compliance with safety standards and accident prevention.</p>	<p><b>Application Level:</b> Use Lockout/Tagout (LOTO) techniques appropriately and safely in the mechatronic laboratory environment, following established procedures and protocols to ensure student safety and equipment system integrity.</p> <p><b>Analysis Level:</b> Examine and evaluate the Lockout/Tagout (LOTO) procedures used in the mechatronic laboratory, identifying potential improvements in terms of efficiency and safety, and proposing solutions to optimize the lockout/tagout processes.</p> <p><b>Evaluation Level:</b> Evaluate and monitor compliance with Lockout/Tagout (LOTO) procedures in the mechatronic laboratory environment, ensuring adherence to protocols and standards to maintain a safe working environment for students and equipment.</p>
<p><b>MODULE 4</b> Advancing Mathematical Skills and Professional Development: Precision Measurement Lab</p>	<p>This revised unit is designed to solidify students' mathematical skills and their understanding of precision measurement, magnetism, and prepare them for the professional world. The initial focus is on advanced math practice and a deep dive into magnetism, guided by Gage Simpson. To facilitate career readiness, the unit incorporates a resume-building workshop preparing students with practical job-search skills.</p> <p>In the second session, students apply their honed mathematical skills and magnetism knowledge in a comprehensive precision measurement lab. This hands-on session covers essential techniques, such as reading an inch micrometer as per Starrett guidelines, understanding metric Vernier calipers, and measuring up to 1/16th of an inch. A special segment includes a quick tour to learn how to measure and read a dial caliper. These activities bridge the gap between theoretical knowledge and practical application, providing invaluable insights into real-world scenarios in the field of industrial maintenance and mechatronics.</p>	<p>Advanced Mathematics Lab: In this lab session, students will tackle complex mathematical problems that are commonplace in the mechatronics field. The aim will be to utilize these mathematical problems to reinforce their understanding of key concepts and how these concepts are applied practically. Topics could cover calculating areas and volumes, interpreting graphs and tables, and solving equations and systems of equations.</p> <p>Magnetism and Electric Fields Lab: During this lab session, students get to investigate and experiment with magnetic and electric fields, using magnets, coils, wires, and other components. This lab will allow students to see how magnetism is applied in mechatronics, such as in motors, sensors, and control systems.</p> <p>Precision Measurement and Calibration Lab: In this lab session, students will utilize a variety of measurement and calibration instruments to perform precise measurements. They will learn how to accurately read an inch micrometer, a metric Vernier caliper, and how to measure up to 1/16th of an inch. They can also apply this knowledge towards calibrating machines and components, an essential skill for any mechatronics technician working in the field.</p>	<p><b>Application Level:</b> Employ advanced mathematical skills, such as using micrometers and Vernier calipers, to perform precision measurements following Starrett guidelines in the context of the precision measurement lab.</p> <p><b>Analysis Level:</b> Reason and solve complex mathematical problems related to precision measurements, such as interpreting measurements in fractions of an inch and understanding the scales and ranges of the measurement instruments used in the laboratory.</p> <p><b>Evaluation Level:</b> Evaluate the accuracy and precision of measurements conducted in the precision measurement lab, comparing them to established measurement standards and using appropriate verification and validation techniques.</p>	<p><b>Application Level:</b> Apply mechatronics knowledge, technical skills, and practical expertise gained in the precision measurement lab to design, build, and test mechatronic systems that require precision measurements.</p> <p><b>Analysis Level:</b> Analyze and evaluate complex mechatronic systems in terms of precision measurements, identifying and solving problems related to the integration of mechanical, electrical, and control components in the systems.</p> <p><b>Evaluation Level:</b> Observe and compare different techniques and tools used in the precision measurement lab, considering their effectiveness and efficiency in performing precision measurements in the context of mechatronics.</p>	<p><b>Application Level:</b> Apply learned precision measurement techniques such as: using micrometers and Vernier calipers, to perform accurate measurements on various mechatronic components and devices.</p> <p><b>Analysis Level:</b> Examine and evaluate the results of measurements conducted in the precision measurement lab, identifying discrepancies or deviations and analyzing possible causes or sources of error in the measurement process.</p> <p><b>Evaluation Level:</b> Evaluate the quality and accuracy of measurements conducted in the precision measurement lab, using statistical analysis techniques and comparing them to established standards and specifications.</p>
<p><b>MODULE 5</b> Mastering Electrical Measurement Tools and Introduction to DC Circuits</p>	<p>This unit equips students with the practical know-how of handling industrial measurement tools such as digital multimeters, circuit testers, and further dives into the area of electrical circuit analysis. The foundation of the course begins with a deep understanding of electrical power generation, paving the way for a deeper exploration of DC circuits.</p> <p>Theoretical instruction is complemented with practical examples focusing on critical concepts such as voltage, current, resistance, and power. This includes learning to accurately read resistance values, a skill integral to circuit analysis and troubleshooting. Students will master the application of Ohm's Law and Kirchhoff's Laws to calculate unknown values in DC circuits, analyze their behavior, and solve complex circuit problems.</p> <p>Moreover, this unit highlights the pivotal role of electric current in the field of mechatronics, offering an understanding of electrical power systems that underpin most modern automation and control processes. The combination of practical skills and theoretical knowledge ensures that students are prepared for real-world scenarios in the mechatronics industry.</p>	<p>Digital Multimeter Practical Exercise: In this activity, students can gain hands-on experience with a digital multimeter. They will be connected to a flowchart to identify types of circuits and make accurate voltage, current, and resistance measurements. This exercise will also cover the interpretation of readings and troubleshooting of common electrical issues using a multimeter.</p> <p>DC Circuit Analysis Lab: Students will construct simple to complex DC circuits using a breadboard, resistors, power supplies, and other relevant components. They will apply their knowledge of Ohm's Law and Kirchhoff's Laws to calculate and measure circuit parameters like voltage, current, and resistance. This practical exercise will reinforce their understanding of DC circuit theory and provide experience with real-world electrical circuit analysis and problem-solving.</p> <p>Resistance Reading and Identification Exercise: This lab activity will familiarize students with various types of resistors and how to interpret their resistance values using color codes. They will practice measuring the resistance of these components using a multimeter and compare the readings with the theoretical values calculated from the color codes. This practical experience will enhance students' understanding of resistors and their role in controlling the flow of electricity in DC circuits.</p>	<p><b>Application Level:</b> Apply mathematical principles to calculate unknown values, such as voltage, current, and resistance, in DC circuits, demonstrating proficiency in using various electrical measurement tools and problem-solving.</p> <p><b>Analysis Level:</b> Identifies the behavior of DC circuits by applying mathematical concepts such as voltage, current, and resistance, identifying and interpreting patterns and relationships between these variables, and making informed conclusions about circuit performance.</p> <p><b>Evaluation Level:</b> Test and justify the effectiveness of mathematical techniques used in DC circuit analysis, considering factors such as accuracy, precision, and compatibility with industry standards, and making informed judgments about their suitability for specific applications.</p>	<p><b>Application Level:</b> Make use of practical knowledge and skills in handling electrical measurement tools, such as digital multimeters and circuit testers, to accurately measure voltage, current, resistance, frequency, phase, and power in mechatronic systems.</p> <p><b>Analysis Level:</b> Investigate the role of electric current in mechatronic systems and their impact on automation and control processes, examining the interplay between electrical power systems and mechanical components, and identifying opportunities for optimization and improvement.</p> <p><b>Evaluation Level:</b> Evaluate the effectiveness and efficiency of electrical measurement techniques and tools used in mechatronic systems, considering factors such as accuracy, reliability, and compatibility with industry standards, and making informed judgments about their suitability for specific applications.</p>	<p><b>Application Level:</b> Apply practical skills and techniques learned in the laboratory to accurately measure and analyze electrical parameters, such as voltage, current, and resistance, using digital multimeters and circuit testers in controlled experiments and real-world scenarios.</p> <p><b>Analysis Level:</b> Analyze and interpret experimental data obtained from electrical measurements in the laboratory, identifying trends, patterns, and potential sources of error, and drawing meaningful conclusions about the behavior and characteristics of electrical circuits.</p> <p><b>Evaluation Level:</b> Evaluate the validity and reliability of experimental results obtained from electrical measurements, comparing them to theoretical expectations and established standards, and making informed assessments of measurement accuracy, precision, and experimental procedure effectiveness.</p>
<p><b>MODULE 6</b> Exploring AC/DC Circuit Analysis: Power and Power Factor</p>	<p>This unit introduces students to the basic principles of Direct Current (DC) and Alternating Current (AC) circuits, led by a specialized AC instructor. The curriculum aims to reinforce students' mathematical abilities through practicing scientific and engineering notation, pivotal in comprehending and calculating electrical quantities.</p> <p>The focus then expands to the comprehensive analysis of series DC circuits, power consumption in DC circuits, as well as understanding and applying AC circuit analysis techniques. This will entail theoretical derivations of basic such as Ohm's Law</p>	<p>Circuit Construction and Analysis Exercise: Students will design and analyze series DC AC circuits in series configurations. They will construct the circuits using appropriate components and wiring, ensuring proper connections. The exercise will incorporate key principles such as Ohm's Law to calculate unknown circuit parameters. Using electrical measuring tools like multimeters and circuit testers, students will measure voltage, current, and resistance. They will compare the measured values to the theoretical calculations based on Ohm's Law to validate the results. This activity provides hands-on experience in circuit construction, measurement, and analysis, reinforcing their understanding of DC and AC circuits.</p> <p>Circuit Behavior Prediction and Analysis: Students will be given circuit diagrams of simple DC circuits and will be tasked with predicting the behavior of the circuits. They will apply their knowledge of Ohm's Law and other relevant principles to calculate values such as voltage, current, and resistance in different components of the circuit. Students will use their understanding of circuit</p>	<p><b>Application Level:</b> Apply mathematical principles to electrical quantities. The objective is to apply mathematical principles, including scientific and engineering notation, to comprehend and calculate electrical quantities such as voltage, current, resistance, frequency, phase, and power in AC/DC circuits. This objective aims to develop students' proficiency in using mathematical analysis to understand and calculate electrical quantities.</p> <p><b>Analysis Level:</b> Investigate and interpret circuit behavior: The objective is to investigate and interpret the behavior of series and parallel DC circuits, including power consumption. By applying mathematical concepts and laws such as Ohm's Law, Kirchhoff's Laws, and the</p>	<p><b>Application Level:</b> Apply AC/DC circuit principles in mechatronic systems: The objective is to apply AC/DC circuit principles and analysis techniques to design and construct mechatronic systems that utilize electrical power. This objective focuses on ensuring compatibility, efficiency, and functionality of electrical components within the overall mechatronic system.</p> <p><b>Analysis Level:</b> Analyze integration of AC/DC circuits in mechatronic systems: The objective is to analyze the integration of AC/DC circuit principles and components within mechatronic systems. Students will evaluate the impact of these circuits on system performance, ensuring efficiency and safety. This objective aims to</p>	<p><b>Application Level:</b> Apply practical skills and techniques learned in the laboratory to construct and analyze AC and DC circuits, measuring circuit properties such as voltage, current, resistance, and power, and demonstrating proficiency in using electrical measurement tools and equipment.</p> <p><b>Analysis Level:</b> Examine and interpret experimental data obtained from AC/DC circuit measurements in the laboratory, identifying trends, patterns, and deviations from theoretical expectations and making</p>

<p>ENHANCING STUDENT LEARNING: Analysis, Design and Power Consumption</p>	<p>Students will construct and analyze simple DC circuits, using their knowledge to measure circuit properties and predict their behavior. As the unit progresses, students will also explore how these principles apply in mechatronics design and maintenance, especially in relation to electrical power systems and the use of AC and DC currents in mechatronic applications.</p>	<p>Students will use the scientific method to design and build a simple DC circuit. They will use their knowledge to measure circuit properties and predict their behavior. As the unit progresses, students will also explore how these principles apply in mechatronics design and maintenance, especially in relation to electrical power systems and the use of AC and DC currents in mechatronic applications.</p>	<p>Students will use the scientific method to design and build a simple DC circuit. They will use their knowledge to measure circuit properties and predict their behavior. As the unit progresses, students will also explore how these principles apply in mechatronics design and maintenance, especially in relation to electrical power systems and the use of AC and DC currents in mechatronic applications.</p>	<p>Students will use the scientific method to design and build a simple DC circuit. They will use their knowledge to measure circuit properties and predict their behavior. As the unit progresses, students will also explore how these principles apply in mechatronics design and maintenance, especially in relation to electrical power systems and the use of AC and DC currents in mechatronic applications.</p>
<p>MODULE 7 Practical Insights into Motors and Mathematical Conversions in Mechatronics</p>	<p>This comprehensive unit is specifically designed to offer students a detailed understanding of single-phase and three-phase electrical systems, coupled with essential engineering mathematics principles. The module commences with a practical exploration of both single-phase and three-phase motors within a hands-on Lamp Lab context. In this immersive environment, students gain an appreciation for the operation, design, and practical applications of these motors in real-world mechatronics scenarios, illuminating their pivotal role in today's industrial landscape.</p> <p>Further enriching the students' learning experience, the module transitions to intricate mathematical concepts such as scientific and engineering notation and significant figures. This equips the students with the skills required for precise unit conversions - an indispensable proficiency in the mechatronics domain.</p> <p>Consolidating the technical knowledge of electrical systems with these mathematical concepts, students engage with Ohm's Law and series circuit analysis. The integration of these elements enables students to accurately calculate, measure, and convert various units frequently encountered in the industry, emphasizing the significance of precise measurement and conversion for successful implementation within mechatronic systems.</p> <p>Overall, this unit adeptly merges the theoretical aspects with practical application, fostering a deeper comprehension of the subject matter, and arming students with the essential skills required in the mechatronics industry.</p>	<p>Single-Phase and Three-Phase Motors Lab: In this lab, students will work with actual single-phase and three-phase motors, learning to set them up, operate them, and analyze their performance under different conditions. They will use various measurement tools to collect and interpret data, such as voltage, current, and power consumption, thereby developing a hands-on understanding of these motors' operation in industrial settings.</p> <p>Scientific and Engineering Notation Lab: This lab focuses on mathematical conversions and calculations using scientific and engineering notation. Through exercises involving real-world scenarios in mechatronics, students will hone their skills in converting units, handling significant figures, and performing complex calculations. This lab will fortify their mathematical competence, an essential aspect of being a proficient mechatronics technician.</p> <p>Ohm's Law and Series Circuit Analysis Lab: This practical exercise involves constructing and analyzing series circuits, utilizing Ohm's Law to calculate unknown parameters. Students will measure the voltage, current, and resistance across various components in the circuit, thereby gaining a comprehensive understanding of series circuits and Ohm's Law application. This hands-on experience will be invaluable in understanding electrical principles that underpin mechatronic systems.</p>	<p>Application Level: Make use of scientific and engineering notation, as well as significant figures, to accurately perform unit conversions in mechatronics, demonstrating proficiency in mathematical precision and the ability to convert between different units encountered in the industry.</p> <p>Analysis Level: Use mathematical concepts and principles, such as scientific notation and significant figures, to interpret and evaluate numerical data and calculations, identifying errors or inconsistencies and making informed judgments about measurement accuracy and precision.</p> <p>Evaluation Level: Evaluate the effectiveness and efficiency of mathematical conversion techniques used in mechatronics, considering factors such as system performance, response time, and safety, and making informed judgments about the most appropriate conversion methods for specific mechatronic applications.</p>	<p>Application Level: Apply practical skills and knowledge gained in the laboratory to conduct experiments and measurements on single-phase and three-phase motors, analyzing their operational characteristics and performance using appropriate testing and measurement equipment.</p> <p>Analysis Level: Analyze experimental data obtained from motor measurements in the laboratory, examining trends, patterns, and relationships between motor parameters and performance, and making informed conclusions about the behavior and efficiency of single-phase and three-phase motors.</p> <p>Evaluation Level: Evaluate the accuracy and reliability of experimental results obtained from motor measurements, comparing them to theoretical expectations and industry standards, and making informed assessments of measurement precision, potential sources of error, and the validity of laboratory procedures.</p>
<p>MODULE 8 Fundamentals of Pneumatic and Hydraulic Systems in Mechatronics</p>	<p>In this unit, students acquire comprehensive knowledge of pneumatic and hydraulic systems, focusing on their components, functions, and applications in the field of mechatronics. Covering both theoretical principles and practical skills, students learn about key system parts like pumps, valves, and cylinders, their interactions, and their roles in applications such as lifting systems or hydraulic presses for hydraulics, and air compressors and valves in pneumatics. Hands-on sessions offer real-world experience, equipping students with problem-solving capabilities and maintenance techniques, preparing them for a professional setting. The unit concludes with a test to assess the student's proficiency in both pneumatic and hydraulic systems.</p>	<p>Hydraulic System Simulation Lab: In this lab, students can build a small-scale hydraulic system with components such as pumps, valves, and cylinders. This practice involves setting up the system, conducting functionality tests, and troubleshooting any issues. It enables students to understand the practical implementation of hydraulics and the workings of each component.</p> <p>Pneumatic Circuit Construction and Analysis Lab: Here, students design and build a basic pneumatic circuit using an air compressor and various valves. They will evaluate the performance of the circuit and observe the impact of altering pressure and flow rate. This hands-on experience provides an understanding of pneumatic systems and their operation.</p> <p>Maintenance and Troubleshooting Lab for Hydraulic and Pneumatic Systems: This lab involves diagnosing and fixing issues in hydraulic and pneumatic systems. Students will be presented with systems having specific faults and will use their knowledge and problem-solving skills to identify and repair these faults. This exercise helps prepare students for real-world maintenance and troubleshooting tasks in a professional setting.</p>	<p>Application Level: Apply mathematical principles, such as formulas for calculating pressure, flow rate, and force, to analyze and solve problems related to pneumatic and hydraulic systems in mechatronics, demonstrating proficiency in mathematical application for system analysis.</p> <p>Analysis Level: Differentiate mathematical relationships between variables in pneumatic and hydraulic systems, such as the impact of changing pressure or flow rate on force output, and make informed conclusions about system performance and behavior based on mathematical analysis.</p> <p>Evaluation Level: Evaluate the accuracy and reliability of mathematical calculations used in the analysis of pneumatic and hydraulic systems, comparing results to experimental data or established standards, and making informed judgments about the validity and precision of mathematical models in predicting system behavior.</p>	<p>Application Level: Apply knowledge of pneumatic and hydraulic components and their interactions to design and assemble functional systems for specific mechatronic applications, demonstrating proficiency in system integration and problem-solving.</p> <p>Analysis Level: Compare the behavior and performance of pneumatic and hydraulic systems, considering factors such as pressure, flow rate, force, and component characteristics, and make informed conclusions about system efficiency, reliability, and optimization potential.</p> <p>Evaluation Level: Evaluate the effectiveness of pneumatic and hydraulic systems for specific mechatronic applications, considering factors such as system performance, response time, and safety, and making informed judgments about system selection and improvement opportunities.</p>
<p>MODULE 9 Programming and Troubleshooting PLC Control Systems in Mechatronics</p>	<p>This unit, "Programming and Troubleshooting PLC Control Systems in Mechatronics," guides students through key aspects of electronic control systems used in automation, such as Programmable Logic Controllers (PLC) and ladder logic. The unit provides a comprehensive understanding of these systems, highlighting their role in optimizing efficiency and productivity in industrial environments, and offers practical exercises in programming and configuration. Additionally, students will explore PLCs from both theoretical and practical perspectives, understanding their core functionality and programming paradigms. Attention is given to the application of these systems for process monitoring and control in manufacturing settings, as well as problem-solving strategies and maintenance procedures, encompassing hardware and software fault detection and correction. Therefore, this unit provides invaluable skills for those pursuing a career in mechatronics, considering the essential role that electronic control systems perform in modern manufacturing processes.</p>	<p>PLC Programming Exercise: In this hands-on session, students will work with a basic logic program on a PLC to effectively control an industrial process. The objective is to provide a practical understanding of how PLCs can automate industrial operations. Students will learn the fundamentals of ladder logic programming and implement the program to automate the process.</p> <p>Fault Diagnosis and Troubleshooting Activity: For this activity, students will work with a PLC-controlled system that contains pre-programmed faults. Their task will be to use diagnostic tools and their understanding of PLC operation to identify and rectify the faults. This activity is designed to simulate the troubleshooting tasks they may encounter in a professional setting.</p> <p>PLC Programming and Simulation: Students will work with simulation software that emulates a PLC environment. They will develop ladder logic programs to control virtual industrial processes. The simulation software will allow them to test and debug their programs, providing a safe and controlled environment to acquire PLC programming skills.</p>	<p>Application Level: Use mathematical concepts, such as Boolean algebra and logic gates, to program and troubleshoot PLC control systems, demonstrating proficiency in using mathematical principles for logical control and decision-making in mechatronic applications.</p> <p>Analysis Level: Analyze the relationship between mathematical instructions and PLC programming, examining the logic and sequencing of ladder logic programs, and making informed conclusions about the expected system behavior based on the analysis of mathematical instructions.</p> <p>Evaluation Level: Evaluate the effectiveness and accuracy of mathematical instructions and programming logic in PLC control systems, comparing system responses to expected outcomes, identifying discrepancies or errors, and making informed judgments about the reliability and efficiency of the programming logic.</p>	<p>Application Level: Apply practical skills and techniques learned in the laboratory to program and troubleshoot PLC control systems, demonstrating proficiency in system configuration, monitoring, and fault diagnosis.</p> <p>Analysis Level: Examine experimental data obtained from PLC control system testing and troubleshooting in the laboratory, examining system responses to different input signals, identifying faults or errors, and making informed conclusions about the root causes of system issues.</p> <p>Evaluation Level: Check the accuracy and reliability of experimental results obtained from PLC control system testing and troubleshooting, comparing them to expected outcomes and industry standards, and making informed assessments of system performance, fault detection, and maintenance effectiveness.</p>
<p>MODULE 10 Quality Assurance and Continuous Improvement in Mechatronics</p>	<p>In this unit, students gain comprehensive knowledge of quality assurance strategies and continuous improvement methodologies which are crucial for excellence in the mechatronics industry. The focus begins with an introduction to fundamental concepts such as statistical process control, risk-based thinking, and Six Sigma methodologies. Students explore practical case studies and carry out exercises to internalize these concepts. Next, the unit delves into widely used quality models such as ISO 9000, Kaizen, Lean Manufacturing, and Total Quality Management. Through simulations and analysis of real-world cases, students understand the implementation of these methodologies for process improvement, defect reduction, and reliable product delivery. The content emphasizes the practical application of these strategies in the context of mechatronics. Students participate in a collaborative project where they must map, analyze and optimize the processes of a simulated mechatronic production line, applying the concepts learned. By the end of the unit, students are expected to be able to critically evaluate processes in an industrial mechatronics environment, identify improvement opportunities, and propose effective solutions based on total quality management and continuous improvement strategies.</p>	<p>ISO 9000 Compliance Audit Role-play: In this activity, students are divided into two groups: one represents the quality management team of a company, and the other acts as ISO 9000 auditors. The quality management team prepares a presentation and provides evidence of compliance with ISO 9000 standards. The auditors evaluate the presentation and examine the evidence to identify areas of non-compliance or potential improvements. This exercise allows students to gain practical understanding of how a compliance audit is conducted and how ISO 9000 standards are applied in a business environment.</p> <p>Demonstration of Statistical Process Control Tools: In this practical activity, students learn to use statistical process control tools to monitor and improve a mechatronic manufacturing process. They are shown how to create and use control charts to visualize process variability and detect possible deviations or anomalies. Statistical techniques for analyzing collected data and making informed decisions on process improvements are also presented. Students have the opportunity to apply these tools in a practical scenario, enhancing their understanding of how statistical control ensures quality and efficiency in mechatronic processes.</p> <p>Kaizen Improvement Project: In this activity, students delve into the principles of continuous improvement through Kaizen and apply these concepts to a specific mechatronic process. They begin by analyzing the current process and identifying areas for potential improvement. They then propose incremental improvements and practices that could be implemented to enhance efficiency, reduce waste, and improve quality in the process. Students present their proposals and explain how these improvements could contribute to a culture of continuous improvement. They also reflect on the challenges and benefits of applying a Kaizen mindset in a mechatronic environment, fostering a deeper understanding of the concept of ongoing improvement and product quality.</p>	<p>Application Level: Apply statistical analysis techniques, such as data collection and interpretation, to assess and improve quality in mechatronic processes, demonstrating proficiency in using mathematical tools for quality assurance and continuous improvement.</p> <p>Analysis Level: Analyze data and performance metrics using statistical methods, such as control charts and process capability analysis, to identify areas for improvement, detect variations, and make informed decisions about process adjustments in order to enhance quality in mechatronics.</p> <p>Evaluation Level: Determine the effectiveness of statistical analysis methods and continuous improvement strategies used in mechatronics, comparing actual outcomes to desired standards or targets, and making informed judgments about the success and impact of quality improvement initiatives.</p>	<p>Application Level: Apply continuous improvement principles and quality models, such as Six Sigma and ISO 9000, to develop and implement quality management systems in mechatronic processes, demonstrating proficiency in integrating quality practices into mechatronic operations.</p> <p>Analysis Level: Analyze mechatronic processes and systems, identifying opportunities for quality improvement, waste reduction, and efficiency enhancement, and making informed conclusions about the impact of quality management strategies on overall system performance.</p> <p>Evaluation Level: Evaluate the effectiveness and efficiency of quality management systems in mechatronics, considering factors such as customer satisfaction, process efficiency, and adherence to quality standards, and making informed judgments about the success and sustainability of quality improvement initiatives.</p>
<p>MODULE 11 Lean Manufacturing and Quality Control in Mechatronics</p>	<p>This unit, titled "Lean Manufacturing, Total Quality Management, and Quality Control in Mechatronics," introduces students to the principles of Total Quality Management (TQM) and Lean Manufacturing, emphasizing the integral role of quality and continuous improvement and maintenance principles in industrial process management. The unit also provides insights into essential safety measures, equipment usage, and techniques relevant to the mechatronics field. Students will have the opportunity to apply these principles hands-on through practical projects, thus ensuring they can optimize machine life cycles and select appropriate materials for diverse tasks.</p> <p>Theoretical instruction is supplemented with industry-standard resources and an introduction to quality and continuous improvement concepts. The unit's evaluation is conducted through multiple-choice and reflective questions related to maintenance, quality management practices, and lean manufacturing.</p> <p>Incorporating these comprehensive learning modules, this unit equips future technicians with vital skills and knowledge for their success in various modern manufacturing environments, aligning with the evolving trends and practices in total quality management and lean manufacturing.</p>	<p>Lean Manufacturing Simulation: In this exercise, students participate in a simulated production environment to understand the principles of lean manufacturing. The simulation should be designed to demonstrate key concepts such as waste identification and reduction, work in progress (WIP) limits, and continuous improvement. Through a series of production runs, students can experiment with different approaches and observe the impact on efficiency and product quality.</p> <p>Total Quality Management (TQM) Case Study Analysis: Students are provided with real-world case studies showcasing successful and unsuccessful TQM implementations in various industries. The aim is to analyze these case studies to identify critical factors, identifying trends, patterns, or variations, and making informed conclusions about the effectiveness of lean manufacturing practices in maintaining quality standards.</p> <p>Maintenance Record-Keeping Exercise: This practice involves a hands-on exercise where students are given the task of tracking the maintenance of a piece of industrial machinery. They will have to document all the maintenance actions performed, parts replaced, and any issues resolved during operation. This exercise not only helps students understand the importance of detailed and systematic record-keeping but also gives them insights into predictive and preventive maintenance strategies.</p>	<p>Application Level: Apply statistical analysis techniques, such as process capability analysis and control charts, to monitor and improve quality in mechatronic processes in lean manufacturing, demonstrating proficiency in using mathematical tools for quality assessment and improvement.</p> <p>Analysis Level: Examine data from quality control measurements and statistical analysis, identifying trends, patterns, or variations, and making informed conclusions about the effectiveness of lean manufacturing practices in maintaining quality standards.</p> <p>Evaluation Level: Evaluate the accuracy and reliability of statistical analysis methods used in quality control, comparing actual outcomes to desired standards or targets, and making informed judgments about the success and sustainability of quality improvement initiatives.</p>	<p>Application Level: Apply lean manufacturing principles and total quality management techniques to optimize quality and efficiency in mechatronic processes, demonstrating proficiency in implementing lean practices and continuous improvement strategies.</p> <p>Analysis Level: Analyze mechatronic systems and processes, identifying areas for improvement, waste reduction, and efficiency enhancement, and making informed conclusions about the impact of lean manufacturing and quality control practices on overall system performance.</p> <p>Evaluation Level: Evaluate the effectiveness and efficiency of lean manufacturing and quality control practices in mechatronics, considering factors such as process efficiency, waste reduction, customer satisfaction, and adherence to quality standards, and making informed judgments about the success and sustainability of lean initiatives.</p>

<p>MODULE 12 Professionalism and Employment Readiness in Industrial Maintenance</p>	<p>The "Professionalism, Employment Readiness, and Continuous Improvement Models in Industrial Maintenance" unit offers crucial insights into work ethics, professional expectations in the industrial maintenance field, preparation for job market entry, and the application of continuous improvement models like Six Sigma and ISO 9000.</p> <p>The unit begins with a Job Center Presentation, where students gain an understanding of the professional conduct and competencies desired by employers, including the understanding and implementation of recognized quality models such as Six Sigma and ISO 9000.</p> <p>Emphasis is placed on the importance of these models in maintaining high-quality standards, boosting efficiency, and facilitating continuous improvement in industrial processes.</p> <p>The unit concludes with an Employer Showcase and Job Fair, providing students an opportunity to interact with potential employers, demonstrate their understanding of continuous improvement models, and learn about the latest industry trends and job opportunities.</p> <p>This unit aims to equip students with the interpersonal skills, professional preparedness, and knowledge of quality improvement models that supplement their technical expertise, thereby enabling them to effectively navigate the job market in industrial maintenance.</p>	<p>Professional Conduct Simulation: In this interactive classroom exercise, students participate in role-play scenarios that simulate real-world workplace situations. Scenarios may include addressing ethical dilemmas, dealing with workplace conflicts, or practicing good communication skills. This hands-on experience allows students to apply their knowledge of professional conduct in a controlled, educational environment.</p> <p>Quality Improvement Project Presentation: Students are tasked with developing a small project utilizing either Six Sigma or ISO 9000 principles to solve a hypothetical issue in a mechatronics setting. Once completed, students present their solution to the class, explaining their thought process, the steps they took to implement the solution, and how they ensured adherence to the chosen quality model. This exercise enhances their practical understanding of continuous improvement models and hones their presentation skills.</p> <p>Mock Job Fair: This activity involves organizing a mock job fair within the classroom. Each student is given a role, either as a job seeker or employer. Job seekers prepare their resumes, practice their interviewing skills, and pitch their capabilities to the employers. Employers, in turn, provide feedback on the job seekers' performance, resumes, and overall preparedness. This activity can give students practical experience with job market dynamics, help improve their networking skills, and provide a better understanding of employer expectations in the Industrial Maintenance field.</p>	<p>Application Level: Apply mathematical analysis techniques, such as data interpretation and problem-solving, to assess and improve quality in mechatronic processes, demonstrating proficiency in using mathematical tools for continuous improvement and quality enhancement.</p> <p>Analysis Level: Analyze data from quality improvement initiatives and performance metrics, identifying patterns, trends, or correlations and making informed conclusions about the effectiveness of continuous improvement models, such as Six Sigma and ISO 9000, in enhancing mechatronic processes.</p> <p>Evaluation Level: Measure the effectiveness and efficiency of continuous improvement models used in mechatronics, comparing actual outcomes to desired standards or targets, and making informed judgments about the impact of these models on overall process performance and quality.</p>	<p>Application Level: Apply professional ethics and interpersonal skills, such as effective communication and teamwork, to enhance workplace collaboration and contribute to continuous improvement efforts in industrial maintenance, demonstrating proficiency in professional conduct and engagement.</p> <p>Analysis Level: Analyze the principles and practices of continuous improvement models, such as Six Sigma and ISO 9000, in the context of mechatronics, examining their impact on quality management, process efficiency, and overall performance, and making informed conclusions about their applicability and effectiveness in industrial maintenance.</p> <p>Evaluation Level: Assess the alignment between personal competencies, including knowledge of continuous improvement models, and employer expectations in the industrial maintenance field, by comparing individual skills and attributes to industry requirements, and making informed judgments about professional readiness and potential areas for improvement.</p>	<p>Application Level: Apply practical skills and techniques learned in the laboratory to demonstrate professionalism, attention to detail, and adherence to safety protocols in industrial maintenance projects and activities, demonstrating proficiency in workplace readiness and responsibility.</p> <p>Analysis Level: Analyze and reflect upon personal performance and behaviors in laboratory settings, identifying areas for improvement, such as time management, organization, or collaboration, and making informed conclusions about the impact of these factors on project outcomes and overall professionalism.</p> <p>Evaluation Level: Evaluate the effectiveness and professionalism of laboratory practices and interactions, considering factors such as adherence to safety guidelines, teamwork, and quality of deliverables, and making informed assessments of personal growth and readiness for industrial maintenance employment.</p>
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