

## WTCS Repository

# Program Design

50-620-1 MECHATRONICS TECHNICIAN APPRENTICE

Description

This occupation requires combined knowledge of electrical, electronic and mechanical systems used in industrial plants. Workers frequently support automation and robotic technologies. Work processes include installing, repairing, and maintaining equipment/devices. Troubleshooting systems involved in manufacturing and process control are critical requirements for workers in these occupations. Workers typically operate and debug, industrial computer and communication systems including PLC’s, PCs, and HMI technologies. Workers machine metal and other materials; fabricate parts and weld/join components. Documenting work performed, maintaining accurate records, and working in a collaborative environment are critical interpersonal skills. Employees in some, but not all plants, support facilities, utilities and grounds. More information can be found in the Occupational Outlook Handbook at www.bls.gov.

External Requirements

APPRENTICESHIP TRAINING STANDARDS

5-year apprenticeship under the hybrid model of both time-based and competency based

10,000 hours

864 hours of related instruction completed in 3 years

Complete Transition to Trainer course in the final year

Entry Requirements

Wisconsin registered apprentice.

### Program Outcomes

|  |  |
| --- | --- |
| 1 | Perform work safely |
| 2 | Install mechanical equipment |
| 3 | Install electrical equipment |
| 4 | Maintain mechanical equipment |
| 5 | Troubleshoot mechatronic systems |
| 6 | Operate machine shop tools and machines |
| 7 | Weld and fabricate parts |
| 8 | Maintain automation systems |
| 9 | Modify devices and systems |
| 10 | Maintain documents and records |
| 11 | Local options and work processes |

# 50-620-1 Mechatronics Technician Apprentice Related Instruction Model [2016-17]

Description

This program configuration represents a statewide model for class cohorts in the related instruction portion of the mechatronics technician apprenticeship. The model outlines related instruction for 3 years and 6 semesters (terms). It reflects a total of 864 hours of combined on-campus lecture, demonstration, shop, and hands-on learning aligned with DWD-BAS apprenticeship training standards. This model is designed for class meetings one day per week, and every week during 2 semesters per year. This model provides foundational skills apprentices will need in on-the-job learning during the final 2 years of their apprenticeship. The model provides 288 hours of learning in each of the following disciplines: mechanical, electrical, and automation.

This model aligns WTCS learning outcomes with relevant industry/manufacturing standards as identified by an industry validated DACUM and Exhibit A work processes approved by the state trade committee. Supporting documentation may be found in the BAS Mechatronics Technician Job Book pending in 2016-7. The model also aligns common and consistent course numbers that colleges may use across the WTCS (along with recommended hours, credits and pre-requisites).

This curriculum model may be interpreted and implemented by the colleges as required to meet local needs and in support of local work processes approved by the trade and DWD-BAS.

Credits

|  |  |
| --- | --- |
| Total Credits | 24 |

## Term 1

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-701 | Trade Math Review for Mechatronics Apprentices | 1 |
| 50-620-702 | Mechatronic Principles | 2 |
| 50-620-703 | DC Electricity for Mechatronics | 1 |

## Term 2

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-704 | AC Electricity for Mechatronics | 1 |
| 50-620-705 | Motors & Motor Control for Mechatronics | 2 |
| 50-620-706 | Electrical Codes for Mechatronics | 1 |

## Term 3

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-708 | Fluid Power Systems for Mechatronics Apprentices | 2 |
| 50-620-709 | Servos and Drives for Mechatronics | 1 |
| 50-620-710 | Power Transmission Systems for Mechatronics | 1 |

## Term 4

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-711 | Machining Concepts for Mechatronics | 2 |
| 50-620-712 | Introduction to Programmable Logic Controllers | 2 |

## Term 5

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-714 | HMI Technologies & PLC Applications for Mechatronics | 2 |
| 50-620-715 | Introduction to Robotic Systems for Mechatronics | 2 |

## Term 6

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 50-620-716 | Introduction to Robotic Integration | 3 |
| 50-620-707 | Welding Basics for Mechatronics | 1 |

## Term OTHER

|  |  |  |
| --- | --- | --- |
| Course # | Course Title | Credits |
| 47-455-455 | Transition to Trainer: Your Role as a Journey Worker |  |

### Program Course List

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number | Title | Credits | Description | Pre/Corequisites |
| 50-620-701 | Trade Math Review for Mechatronics Apprentices | 1 | Course competencies include building apprentice skills working with fractions, decimals, formulas and ratios commonly used by the trade. Measurement, tolerances and interpreting trade related information will help apply math concepts to industrial and manufacturing work processes. Basic algebra, geometry and trigonometry will be applied to mechatronics job duties and tasks. Converting between US and metric units is also included.  Course provides a foundation for mechanical and electrical problem-solving involving math. | Wisconsin Registered Apprentice |
| 50-620-702 | Mechatronic Principles | 2 | Course learning outcomes will examine both introductory mechanical & electrical concepts as a foundation for future coursework and on-the-job learning. Troubleshooting principles associated with mechatronics will also be introduced. Apprentices will explore safety, rigging, measurement, mechanical principles, electrical principles, mechanisms, metallurgy, and troubleshooting. |  |
| 50-620-703 | DC Electricity for Mechatronics | 1 | This course introduces the fundamental concepts and computations related to DC electricity. Emphasis is placed on circuit analysis and the problem-solving skills necessary for the maintenance of mechatronic systems and manufacturing equipment. Competencies related to metering and safe use of measuring devices are included. | Wisconsin Registered Apprentice. 50-620-701 Trade Math Review for Mechatronics is recommended. |
| 50-620-704 | AC Electricity for Mechatronics | 1 | This course is designed to introduce the mechatronic technician apprentice to the basic concepts of alternating current. Emphasis is placed on circuit analysis and the problem-solving skills necessary for the maintenance of mechatronic systems and manufacturing equipment. | Wisconsin Registered Apprentice 50-620-701 Trade Math Review for Mechatronics is recommended. 50-620-703 DC Electricity for Mechatronics is recommended. |
| 50-620-705 | Motors & Motor Control for Mechatronics | 2 | This course examines the fundamentals of electric motors and motor control. Apprentices will learn to recognize and draw basic symbols, use the language of motor control, and apply these in industry adopted formats. Apprentices will also learn to draw and read ladder and wiring diagrams, and be introduced to the logic used in motor control.  Learners will apply this logic to correctly interpret, install, service, and wire control circuits. Wiring of panels, machines, and systems will also be examined. | 50-620-701 Trade Math Review for Mechatronics is recommended. 50-620-704 AC Electricity for Mechatronics is recommended. |
| 50-620-706 | Electrical Codes for Mechatronics | 1 | Apprentices will examine the National Electric Code and apply information to work practices involving mechatronic systems.  Terminology needed to communicate and coordinate electrical work with other trades will be explored. | 50-620-704 AC Electricity for Mechatronics is recommended. First year apprentices who successfully completed term 1 |
| 50-620-707 | Welding Basics for Mechatronics | 1 | Course compares common welding processes and develops apprentice skills related to welding, cutting, heating and using oxy-gas.  Welding with arc and MIG will help develop competency working with metal.  Additional course learning outcomes may include common cutting and joining techniques associated with applicable trade work processes. |  |
| 50-620-708 | Fluid Power Systems for Mechatronics Apprentices | 2 | Course learning outcomes include inspecting, testing, servicing, and troubleshooting hydraulic, pneumatic, compressed air, and vacuum systems. Apprentices will review safety procedures for various common maintenance tasks. | 50-620-701 Trade Math Review for Mechatronics is recommended. |
| 50-620-709 | Servos and Drives for Mechatronics | 1 | Course introduces concepts, terminology, and safety associated with drives and servos used in industry and manufacturing. Course is designed to give the apprentice the knowledge required to program, service and maintain variable frequency drives and related equipment.  Course learning outcomes include setting up and programming drives in a lab, shop or training center setting. | 50-620-704 AC Electricity for Mechatronics is recommended. |
| 50-620-710 | Power Transmission Systems for Mechatronics | 1 | Course learning outcomes include examining mechanical power transmission systems and components.  Belts, chain drives, gears & gear drives, couplings, and clutches & brakes will be examined. Apprentices will develop skills inspecting, installing, and maintaining power transmission systems and troubleshooting failures. Apprentices will also learn about safety, documenting work performed, communicating the status of work, and working collaboratively. | 50-620-701 Trade Math Review for Mechatronics is recommended. 50-620-702 Mechatronic Principles is recommended. |
| 50-620-711 | Machining Concepts for Mechatronics | 2 | Course introduces cutting, drilling, lathes, and milling operations to apprentices in mechatronics.  Course topics also include work holding devices, measuring tools and measurement, safety, machine guards, tooling, print reading, and speeds & feeds.  Math skills will be applied to machining related work practices. | 50-620-701 Trade Math Review for Mechatronics is recommended. Second year apprentice. |
| 50-620-712 | Introduction to Programmable Logic Controllers | 2 | This course is designed to teach the fundamentals of programmable logic controller and its programming software. The course will introduce terminology, concepts, schematic reading and basic programming.  Technologies and PLC use in manufacturing and mechatronic systems will be emphasized. | 50-620-704 AC Electricity is recommended. 50-620-705 Motors and Motor Control for Mechatronics is recommended. 50-620-709 Servos and Drives for Mechatronics is recommended. |
| 50-620-714 | HMI Technologies & PLC Applications for Mechatronics | 2 | Human machine interface devices, software and technologies will be examined for mechatronic systems.  Apprentices will work in a lab/shop/training center setting to create touchscreens, set-up networks, and configure systems. | 50-620-712 Introduction to Programmable Logic Controllers is recommended. |
| 50-620-715 | Introduction to Robotic Systems for Mechatronics | 2 | Course introduces the apprentice to the robot teach pendant and methods of robot jogging. Learners will be taught to replace servo motors, re-master the robot, and back up robot software and programs.  Maintenance, servicing and safety will be emphasized.  Cable management systems will be examined. | 50-620-712 Introduction to Programmable Logic Controllers is recommended. |
| 50-620-716 | Introduction to Robotic Integration | 3 | Mechatronic apprentices will explore offsets, vision systems and system integration using robotic simulation and capstone project.  The project will tie everything learned during their apprenticeship together – safety, machine integration, vision systems, CNC, machine applications for robotics, troubleshooting, and work documentation. | 50-602-712, -714, and -715 is recommended. Course intended for 3rd year apprentices prepared to complete a capstone project. |
| 47-455-455 | Transition to Trainer: Your Role as a Journey Worker |  | Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.   You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job. |  |
| 50-804-504 | Industrial Math 1 | 1 | Explore the topics of applied arithmetic and algebra. Study concepts related to measurement, fractions, decimals, percent, ratio and proportion, signed numbers, formula substitution, solutions to equations, tapers and gears. Calculate the areas and volumes of common geometric shapes. |  |
| 50-804-505 | Industrial Math 2 | 1 | Examine topics in geometry and trigonometry that are related to the metalworking trades. Practice applying geometric theorems and solving both right and oblique triangle problems. | 50-804-504, Industrial Math 1 |

50-620-701 Trade Math Review for Mechatronics Apprentices

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course competencies include building apprentice skills working with fractions, decimals, formulas and ratios commonly used by the trade. Measurement, tolerances and interpreting trade related information will help apply math concepts to industrial and manufacturing work processes. Basic algebra, geometry and trigonometry will be applied to mechatronics job duties and tasks. Converting between US and metric units is also included.  Course provides a foundation for mechanical and electrical problem-solving involving math. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | Wisconsin Registered Apprentice |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Solve problems using fractions |
| 2. | Perform math using decimals |
| 3. | Apply measurement information to trade math |
| 4. | Apply basic geometry to the trade |
| 5. | Solve problems using basic algebra |
| 6. | Apply trigonometry concepts to trade math problems |
| 7. | Convert between metric and US units |

50-620-702 Mechatronic Principles

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course learning outcomes will examine both introductory mechanical & electrical concepts as a foundation for future coursework and on-the-job learning. Troubleshooting principles associated with mechatronics will also be introduced. Apprentices will explore safety, rigging, measurement, mechanical principles, electrical principles, mechanisms, metallurgy, and troubleshooting. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Classify safety requirements for mechatronic systems |
| 2. | Use measuring instruments and measurement techniques |
| 3. | Apply mechanical principles to manufacturing processes and equipment |
| 4. | Apply concepts of fasteners to mechatronic systems |
| 5. | Demonstrate the proper use of hand and power tools used by the trade |
| 6. | Compare mechanical equipment commonly found in mechatronic systems |
| 7. | Apply rigging, moving and material handling concepts to various situations |
| 8. | Compare industrial prints, plans and drawings |
| 9. | Apply an introduction to metals & metallurgy to mechatronic work processes |
| 10. | Apply introductory manufacturing concepts to mechatronics |
| 11. | Apply lubrication fundamentals to trade work processes |
| 12. | Examine introductory vibration analysis and ultrasonic testing concepts for mechatronics |
| 13. | Relate ultrasound testing procedures to mechatronic systems |
| 14. | Explore an introduction to troubleshooting for working with mechatronic systems |

50-620-703 DC Electricity for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | This course introduces the fundamental concepts and computations related to DC electricity. Emphasis is placed on circuit analysis and the problem-solving skills necessary for the maintenance of mechatronic systems and manufacturing equipment. Competencies related to metering and safe use of measuring devices are included. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | Wisconsin Registered Apprentice. |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Examine the basic nature of electricity |
| 2. | Perform basic mathematical functions |
| 3. | Compare sources of electricity |
| 4. | Apply units of measure for electrical quantities |
| 5. | Analyze a resistive series circuit |
| 6. | Analyze a parallel circuit |
| 7. | Analyze combination circuits |
| 8. | Analyze principles of magnetism |
| 9. | Examine how electromagnetic devices operate |

50-620-704 AC Electricity for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | This course is designed to introduce the mechatronic technician apprentice to the basic concepts of alternating current. Emphasis is placed on circuit analysis and the problem-solving skills necessary for the maintenance of mechatronic systems and manufacturing equipment. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | Wisconsin Registered Apprentice |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |
| Prerequisite | 50-620-703 DC Electricity for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Apply right angle trigonometry to circuit analysis |
| 2. | Examine characteristics of alternating current |
| 3. | Use AC measuring instruments |
| 4. | Analyze resistive-inductive series circuits |
| 5. | Analyze resistance-capacitive series circuits |
| 6. | Analyze parallel reactive circuits |
| 7. | Compare three-phase systems |

50-620-705 Motors & Motor Control for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | This course examines the fundamentals of electric motors and motor control. Apprentices will learn to recognize and draw basic symbols, use the language of motor control, and apply these in industry adopted formats. Apprentices will also learn to draw and read ladder and wiring diagrams, and be introduced to the logic used in motor control.  Learners will apply this logic to correctly interpret, install, service, and wire control circuits. Wiring of panels, machines, and systems will also be examined. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |
| Prerequisite | 50-620-704 AC Electricity for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Apply safety procedures, tools, and instrument to specific situations |
| 2. | Interpret mechatronic electrical circuits, symbols, diagrams, and abbreviations |
| 3. | Analyze the operation of relays, contactors, and motor starters |
| 4. | Examine timers and timing circuit types used in control circuits |
| 5. | Compare the function of a capacitive, inductive, and photoelectric sensors |
| 6. | Illustrate a timer truth table |
| 7. | Apply DC motor operational theories to mechatronic systems |
| 8. | Select DC motor types for general applications |
| 9. | Compare single phase AC motor components and wiring applications |
| 10. | Analyze three phase AC motor components and wiring applications |
| 11. | Compare motor starting methods for industrial applications |
| 12. | Apply AC motor operational theory to mechatronic systems |
| 13. | Explore motor stopping methods |
| 14. | Apply panel electrical schematics to wiring a motor circuit |
| 15. | Examine diagnostic tests for motor circuits |

50-620-706 Electrical Codes for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Apprentices will examine the National Electric Code and apply information to work practices involving mechatronic systems.  Terminology needed to communicate and coordinate electrical work with other trades will be explored. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-704 AC Electricity for Mechatronics is recommended. |
|  | First year apprentices who successfully completed term 1 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Examine the structure of the National Electric Code |
| 2. | Define requirements of the code that are common to all electrical installations |
| 3. | Plan the installation of an overcurrent protection device |
| 4. | Select the proper conductor and raceway for mechatronics installations selected by the instructor and trade |
| 5. | Apply part A of article 250 (grounding) to industrial electrical situations |
| 6. | Apply part B of article 250 (grounding) to industrial electrical situations |
| 7. | Apply article 300 (wiring methods) to industrial electrical situations |
| 8. | Size cords and cables for typical industrial electrical installations |
| 9. | Plan equipment installation in hazardous locations |

50-620-707 Welding Basics for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course compares common welding processes and develops apprentice skills related to welding, cutting, heating and using oxy-gas.  Welding with arc and MIG will help develop competency working with metal.  Additional course learning outcomes may include common cutting and joining techniques associated with applicable trade work processes. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Identify safety and PPE requirements for welding and metal fabrication |
| 2. | Interpret welding prints and drawings |
| 3. | Apply metallurgical concepts to welding and joining |
| 4. | Examine different welding processes |
| 5. | Heat and cut metal using oxy-gas processes |
| 6. | Arc weld metal |
| 7. | Mig weld metal |
| 8. | Perform other types of cutting processes |
| 9. | Perform other types of joining processes |

50-620-708 Fluid Power Systems for Mechatronics Apprentices

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course learning outcomes include inspecting, testing, servicing, and troubleshooting hydraulic, pneumatic, compressed air, and vacuum systems. Apprentices will review safety procedures for various common maintenance tasks. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Compare safety and PPE requirements for working on or near fluid power systems |
| 2. | Explore the principles of hydraulic systems |
| 3. | Explore the principles of pneumatic systems |
| 4. | Explore the principles of compressed air and vacuum systems |
| 5. | Interpret fluid power system schematic diagrams |
| 6. | Analyze the roles and functions of fluid power system components |
| 7. | Explain the functions of valves used in fluid power systems |
| 8. | Apply hydraulic and pneumatic concepts to servicing mechatronic systems |
| 9. | Apply compressed air concepts to servicing mechatronic systems |
| 10. | Apply vacuum system concepts to servicing mechatronic systems |
| 11. | Build skills troubleshooting principles to mechatronic fluid power systems (pneumatic, hydraulic, compressed air, and vacuum systems) |

50-620-709 Servos and Drives for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course introduces concepts, terminology, and safety associated with drives and servos used in industry and manufacturing. Course is designed to give the apprentice the knowledge required to program, service and maintain variable frequency drives and related equipment.  Course learning outcomes include setting up and programming drives in a lab, shop or training center setting. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-704 AC Electricity for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Interpret schematics for drives and servos |
| 2. | Examine the function and operation of a variable frequency drive applications for mechatronic systems |
| 3. | Set up a variable frequency drive for optimum performance |
| 4. | Troubleshoot a variable frequency drive |

50-620-710 Power Transmission Systems for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course learning outcomes include examining mechanical power transmission systems and components.  Belts, chain drives, gears & gear drives, couplings, and clutches & brakes will be examined. Apprentices will develop skills inspecting, installing, and maintaining power transmission systems and troubleshooting failures. Apprentices will also learn about safety, documenting work performed, communicating the status of work, and working collaboratively. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |
|  | Total Hours | 36 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |
| Prerequisite | 50-620-702 Mechatronic Principles is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Examine different types of belts and their related components |
| 2. | Inspect belt drive systems |
| 3. | Troubleshoot belt drive systems |
| 4. | Remove belt drive components |
| 5. | Select a belt for a belt drive system |
| 6. | Install a belt in a belt drive system |
| 7. | Examine different gear types and their applications |
| 8. | Inspect gear assemblies |
| 9. | Troubleshoot gear and related problems |
| 10. | Examine different drive transmission types and their applications |
| 11. | Examine different types of roller chains and their related components |
| 12. | Inspect transmissions and components |
| 13. | Troubleshoot mechanical drive systems |
| 14. | Examine different types of couplings and their related components |
| 15. | Summarize common troubleshooting failures in mechanical systems |

50-620-711 Machining Concepts for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course introduces cutting, drilling, lathes, and milling operations to apprentices in mechatronics.  Course topics also include work holding devices, measuring tools and measurement, safety, machine guards, tooling, print reading, and speeds & feeds.  Math skills will be applied to machining related work practices. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-701 Trade Math Review for Mechatronics is recommended. |
|  | Second year apprentice. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Identify safety and PPE requirements for each machining operation |
| 2. | Compare measuring tools and measurement |
| 3. | Apply print reading skills to machining related job tasks |
| 4. | Examine cutting operations |
| 5. | Explore drilling operations |
| 6. | Compare lathes and lathe operations |
| 7. | Compare mills and milling operations |
| 8. | Complete a machining project selected by the instructor or trade |

50-620-712 Introduction to Programmable Logic Controllers

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | This course is designed to teach the fundamentals of programmable logic controller and its programming software. The course will introduce terminology, concepts, schematic reading and basic programming.  Technologies and PLC use in manufacturing and mechatronic systems will be emphasized. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-704 AC Electricity is recommended. |
| Prerequisite | 50-620-705 Motors and Motor Control for Mechatronics is recommended. |
| Prerequisite | 50-620-709 Servos and Drives for Mechatronics is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Enter basic programming instructions into the programmable logic controller |
| 2. | Program counter instructions into the PLC program |
| 3. | Program timers in the PLC program |
| 4. | Explore Data Compare instructions |
| 5. | Explore Basic Math instructions |
| 6. | Compare program control instructions |

50-620-714 HMI Technologies & PLC Applications for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Human machine interface devices, software and technologies will be examined for mechatronic systems.  Apprentices will work in a lab/shop/training center setting to create touchscreens, set-up networks, and configure systems. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-712 Introduction to Programmable Logic Controllers is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Explore human machine interface (HMI) software |
| 2. | Explore touchscreen hardware |
| 3. | Create HMI screens for various mechatronic systems |
| 4. | Communicate with a processor |
| 5. | Create interactive objects in HMI software |
| 6. | Configure interactive objects using HMI software |
| 7. | Explore networking standards |
| 8. | Network automation processors |

50-620-715 Introduction to Robotic Systems for Mechatronics

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Course introduces the apprentice to the robot teach pendant and methods of robot jogging. Learners will be taught to replace servo motors, re-master the robot, and back up robot software and programs.  Maintenance, servicing and safety will be emphasized.  Cable management systems will be examined. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 2 |
|  | Total Hours | 72 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-620-712 Introduction to Programmable Logic Controllers is recommended. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Examine robot equipment and safe operation |
| 2. | Demonstrate the ability to perform periodic maintenance tasks on 6-axis robots |
| 3. | Demonstrate re-mastering the robot |
| 4. | Demonstrate the ability to replace a servo drive and motor |
| 5. | Examine advanced maintenance procedures and concepts |
| 6. | Compare cable management concepts for various robotics systems |

50-620-716 Introduction to Robotic Integration

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Mechatronic apprentices will explore offsets, vision systems and system integration using robotic simulation and capstone project.  The project will tie everything learned during their apprenticeship together – safety, machine integration, vision systems, CNC, machine applications for robotics, troubleshooting, and work documentation. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 3 |
|  | Total Hours | 108 |

Pre/Corequisites

|  |  |
| --- | --- |
| Prerequisite | 50-602-712, -714, and -715 is recommended. |
|  | Course intended for 3rd year apprentices prepared to complete a capstone project. |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Demonstrate use of robot frames |
| 2. | Create a robot program |
| 3. | Use robot motion control in programming |
| 4. | Use robotic branching instructions |
| 5. | Contrast between global and program specific commands |
| 6. | Apply a Position Register associated with a User Frame |
| 7. | Apply a math function that adds/subtracts from initial Position Register location |
| 8. | Apply an offset to a Position Register without a formula using equals |
| 9. | Analyze the specifications for selecting a vision process |
| 10. | Determine required hardware and software |
| 11. | Install proper camera set-up |
| 12. | Identify proper vision system set-up |
| 13. | Apply appropriate vision concepts |
| 14. | Demonstrate developing an organized easy to read and follow robot program using only position registers |
| 15. | Integrate touchscreens, PLC, servos and robots for a mechatronic system application |

50-804-504 Industrial Math 1

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Explore the topics of applied arithmetic and algebra. Study concepts related to measurement, fractions, decimals, percent, ratio and proportion, signed numbers, formula substitution, solutions to equations, tapers and gears. Calculate the areas and volumes of common geometric shapes. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Perform arithmetic operations on whole numbers and fractions. |
| 2. | Determine powers and roots. |
| 3. | Solve percentage, ratio and proportion problems. |
| 4. | Perform arithmetic operations on signed numbers. |
| 5. | Evaluate expressions involving order of operations. |
| 6. | Solve equations. |

**50-804-505  Industrial Math 2**

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Examine topics in geometry and trigonometry that are related to the metalworking trades. Practice applying geometric theorems and solving both right and oblique triangle problems. |
|  | Instructional Level | Technical Diploma |
|  | Total Credits | 1 |

**Pre/Corequisites**

|  |  |
| --- | --- |
| Prerequisite | 50-804-504, Industrial Math 1 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Perform basic geometric operations |
| 2. | Apply the Pythagorean Theorem to right triangles |
| 3. | Solve right triangles |
| 4. | Apply laws of Sines and Cosines |
| 5. | Analyze shop applications by constructing triangles |
| 6. | Apply geometric formulas to right and oblique triangles |
| 7. | Solve compound angle applications |

47-455-455 Transition to Trainer: Your Role as a Journey Worker

# Course Outcome Summary

### Course Information

|  |  |  |
| --- | --- | --- |
|  | Description | Apprenticeship training is a collaborative partnership: employer and employee associations, government, and educational institutions each play a part. In reality, most learning takes place through the daily interaction between an apprentice and his/her co-workers. Surveys have shown that the apprentices are least satisfied with the on-the-job portion of their training--particularly the ability of journey level workers and supervisors to pass on their knowledge of the trade.   You have already learned to use the tools of your chosen trade. In this workshop you will be introduced to a new set of basic tools--the tools of a jobsite trainer. You will explore the skills that are necessary to be an effective trainer, discover how to deliver hands-on training, and examine the process for giving useful feedback. During the workshop you will build a Training Toolkit to take back to your work on the job. |
|  | Total Hours | 8 |

### Course Competencies

|  |  |
| --- | --- |
| 1. | Value your role as a journey worker trainer |
| 2. | Serve as a mentor and job coach |
| 3. | Foster a positive work environment by acting as an ally/advocate |
| 4. | Provide hands-on skills training |
| 5. | Provide feedback on apprentice performance |