

## Maintenance & Support Services:

Part #	Description	Unit List Price	NYS Discount %	NYS Net Price
206-ST1	eLearning Set-up and Administration One-time initial set-up for an organization on amatrolelearning.com.	\$2,780.00	10.07%	\$2,500.00
206-M1	eLearning Annual Maintenance Annual maintenance for an organization on amatrolelearning.com starting in year 2. Does not apply to the first year.  Amatrol Support Services Available 8am-5pm Mon-Fri at 1-800-264-8285 Urgent Severity Level guaranteed an immediate to 3 hour response time.	\$445.00	10.11%	\$400.00

### System Requirements

The following are the minimum required system specifications to run the multimedia:

- 1 GHz processor
- 512 MB RAM
- Windows XP
- Sound card (or onboard sound)
- Video card (or onboard video) capable of 800x600 resolution with 24-bit color
- Internet Explorer 5 or newer
- Flash Player 8\*
- Windows Media Player 10\*
- Authorware Web Player\*
- Broadband Internet access (DSL/Cable/T1) capable of 384 kbps

\* In order to view this courseware, you will need three pieces of software (plugins) installed on your computer. All are free and readily available on the internet.

## Consulting & Training Services:

### Description:

Amatrol's e-Learning program meets the challenge for flexible technical training by offering superb technical content depth as well as breadth, strong interactivity for skill development, and excellent assessment and student tracking through an intuitive, **easy-to-use web portal**. With **24 x 7 access**, Amatrol's e-Learning program creates easy access to educational opportunities for technical skill development previously restricted to the classroom. **The material is self-paced, making it ideal for individual use, traditional class settings, or a blended approach**. Amatrol's proven curriculum is problem- solving oriented and teaches technical skills in a wide range of industrially-relevant technologies.

Amatrol's e-Learning program invites students and teachers alike into a highly skilled world where understanding and application integrate seamlessly. Amatrol's **interactive multimedia curriculum** uses a competency-based instructional design that teaches industry standard skills. The material meets students where they are in their understanding and leads them forward. **Eye-popping graph- ics, 3D simulation, video and complete explanations combine with strong interactivity to develop technical skills**. Modern manufacturing involves solving complex problems. Amatrol integrates troubleshooting concepts throughout the e-Learning modules. Problem solving within each topical area starts with the basics and then gradually builds to incorporate the complexity found in real world situations. Students can practice sophisticated troubleshooting techniques with confidence that they can translate it to the workplace.

Amatrol is bringing industrial realism to on-line learning through our **new virtual trainers**. Students can now get the look and feel of using real equipment via their computer. The **virtual trainers replicate hands-on equipment in such great detail that students will feel like they are using the actual equipment**. Students perform essentially the same industry-based tasks using the virtual equipment that they would perform using equipment hardware. With strong market pressure to gain skills quickly, virtual trainers let students develop skills at the speed of business

Amatrol's **e-Learning Management System (eLMS)** is at once both easy to use yet sophisticated in its cap- abilities. It provides complete learning management from course creation through testing and reporting. **Complete Learning Management:**

- Create courses
- Register students
- Monitor student participation
- Track student completion
- Test knowledge levels
- Easily transfer information to other systems
- Access Amatrol's complete module catalog
- Manage skills
- Add organizational logos to customize portal appearance

Each organization controls access to their learning portal and can customize the appearance of the site with a slogan, photo or logo that makes the site truly their own.

### Consulting & Training Services:

Elearning Administrator Consultation and Training is available at **no cost**

**Custom Content** Development and/or Modified/Customized Content Development is available and will be assessed and quoted on a case by case basis. NYS contract users will receive at least a 10% discount on normal custom development costs.

Currently Available  
 Modules as of  
 11/13/2006

## NYS Contract Net Price List

Part #	Description	Unit List Price	NYS Discount %	NYS Net Price	Module Category
206-ST1	eLearning Set-up and Administration One-time initial set-up for an organization on amatrolelearning.com.	\$2,780.00	10.07%	\$2,500.00	
206-M1	eLearning Annual Maintenance Annual maintenance for an organization on amatrolelearning.com starting in year 2. Does not apply to the first year.	\$445.00	10.11%	\$400.00	
W-11103-CB-01	Basic Robot Operation - Robotics is an exciting and rapidly growing area of industry. This module is going to give you an opportunity to develop skills in robotics that will help you get a job in an industry that uses robotics or to get credit at a college. In this unit, you will use the Amatrol Pegasus robot and the Pegasus Robotic Simulation Software (RSS). The Pegasus is a small, table-top robot, but it has a very powerful programming language and is industrially accurate. The Pegasus Robotic Simulation Software allows you to program a virtual robot and test out your program before downloading the program to the real Pegasus robot. Before you finish, you will be designing your own robot programs on an industrial scale. This learning activity packet includes four segments that are designed to teach the basic operation of the robot which include: safety, powerup, shutdown, manual movement, and gripper operation. While these are very basic, it is important that you learn these skills well because you will use them every time you use the robot.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-02	Teach Pendant Programming - Now that you have learned how to turn on the robot and jog it manually using the teach pendant, you are ready to learn how to develop and run an automatic program. In this Module, you will learn the basic structure of a robot programming language and six basic programming commands. The method you will use to enter programs in this Module uses the teach pendant. The teach pendant is an important industrial tool used with most robots. This Module will also give you some of the basics to help you learn how to program the robot using PC software.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-03	PC Software Programming 1 - Now that you have learned the basics of robot operation, you are ready to move on to more advanced topics. In this Module, you will learn about robotic programming software and two methods of using it to program robots. You will also learn how to interface external input and output devices to the robot and apply both skills to design a program that simulates the control of a plastic injection molding machine.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-04	Application Development - This Module covers how to connect a conveyor to the robot and operate the conveyor using two new commands, MON and MOFF. A six-step design process that can be used to develop a robot program is also discussed. You will then use these two new skills to develop a robotic conveyor application.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-05	Flexible Manufacturing Cells - In this Module, you will continue learning about robot applications by developing programs to make a robot load and unload multiple automated machines. To do this, you will learn how to develop a flow chart and a number of new commands which include conditional and subroutine commands. These commands are used in computer programs of all types, not just robots.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-06	Quality Control - Previous Modules covered how to use the PC programming software to develop robot programs online and offline. This Module discusses some new functions of the PC programming software which allows you to directly operate the robot using a PC. Several new program commands and how they can be used in quality control applications are also covered.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-07	Production Control - This Module covers common programming commands used in production. It also covers the expanded use of variables by combining them with mathematical functions, input instructions, and relational operators. These new features will allow you to write programs that can analyze data from the workcell, an operator, or both and make more sophisticated decisions based on this data. These functions are commonly used in robot programming today. They allow the robot to function as a cell controller.	\$10.00	20.00%	\$8.00	Robotics
W-11103-CB-08	Workcell Development - This Module covers the robotic simulation software's workcell development environment and tools. The various workcell components available within the robotic simulation software are discussed, as well as how components are oriented within a workcell and setting up communications between components. A real robot is not needed because all of the skills taught in this Module cover the robot simulation software only.	\$10.00	20.00%	\$8.00	Robotics
W-11104-HA-01	CAD Drawing Fundamentals - Computer-Aided Drafting (CAD) software greatly increases the drafter's ability to quickly and accurately create technical drawings. Learning the skills necessary to operate a CAD system effectively will enable you to produce technical drawings that clearly represent the product. In this Module, you will learn the basic areas of the CAD system and some of the reasons CAD systems are preferred over other drafting methods.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-02	Introduction to Technical Drawings - In this Module, you will learn how to create technical drawings of objects by sketching them. Sketching is an important skill to have even if you can use CAD because sketches are used to communicate initial concepts early in the design stage. Although there are several types of technical drawings, this Module will focus on multiview drawings because they are the most commonly used type in manufacturing.	\$10.00	20.00%	\$8.00	Design Processes

W-11104-HA-03	Multiview CAD Drawings - In the previous Module, you learned how to sketch multiview drawings. In this Module, you will extend your skills by learning how to create multiview drawings with a CAD system. To do this, you will learn some new CAD skills that will build on the ones you already know.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-04	Schematic Diagrams - In this Module, you will learn more about the rules for creating schematic diagrams. You will also learn how to customize a CAD system to allow you to create schematic diagrams quickly.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-05	Sectional Drawings and Fasteners - Sectional views are special views added to a technical drawing to make it easier to understand. In this Module, you will learn how to read sectional views and use CAD to create them. In addition, you will learn how to identify various fasteners and how to represent fasteners in a technical drawing.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-06	3D Drawings - In this Module you will learn the skills necessary to create three-dimensional drawings. You will create them with the 3D Cartesian Coordinate system and also by using thickness and shading. You will also learn how to view and manipulate a 3D drawing. 3D drawings have a broad range of applications for the manufacturing environment. They are used to clarify complicated multiview drawings so that a designer is given a real world version of an object.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-07	Facilities Layout - This Module will teach you how to set up and save a drawing template. A drawing template contains all of the information needed to set the commands of the CAD system to your specifications. This will help you produce drawings faster by reducing the time required to change the default settings in the CAD program. You will also create a drawing of a robotic manufacturing area, which will be used to teach you CAD editing commands and how to determine the production rate of the manufacturing area.	\$10.00	20.00%	\$8.00	Design Processes
W-11104-HA-08	Introduction to CAM-Mill - In this Module, you will learn to use Computer-Aided Manufacturing (CAM) software. This software gives you the ability to draw a part on the computer and generate a program that will run a computer-controlled machine to make the part. The brand of CAM software you will use is a real-world industrial package called Mastercam. Many manufacturers around the world use Mastercam.	\$10.00	20.00%	\$8.00	Design Processes
W-11105-AA-01	Basic Measurement - Quality Assurance is one of the most important functions in society today. Companies all over the world are finding that producing low cost products is no longer the key to being competitive in a global market. Instead, it is more important that these products are produced with high quality. This course, Quality Assurance 1, will teach you the fundamental principles including: measurement, gaging, geometric dimensioning and tolerancing and statistical process control. The ability to produce a high quality product begins with the ability to determine if in fact the products meet the quality standard. Measurement is the process of determining if the products meet this standard. This Module will focus on teaching you how to make dimensional measurements using the U.S. customary system and metric system. To do this, you will use several rules and a tape measure. Although these measurement tools are basic, it is important that you get a solid foundation because you will use these skills in every Module that follows.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-02	Precision Measurement Tools - In this Module you are going to learn to measure using a dial caliper and a micrometer. These two instruments are examples of precision measuring tools that are used in every manufacturing plant in the world to determine if parts meet a quality standard. Whether you are a quality control inspector, machinist, or manufacturing engineer, you will need to be able to use these tools.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-03	Dimensional Gaging - In the previous Modules you learned to measure the dimensions of objects using a number of hand-held measuring instruments. As you found, the way you hold these instruments can affect the accuracy of the measurement. In this Module you are going to learn how to measure objects more accurately using a measurement device called an indicator and fixtures to hold the parts. This method avoids the errors of hand-held instruments. The techniques you will learn in this Module will be applied in many different applications. You will use them to align fixtures for machine setup, more accurately measure parts, and measure features of parts that can't be measured with hand-held tools. In addition to learning these new measurement techniques, you will also learn how to communicate data from a measurement device to a computer. This skill will prepare you for the next Module where you will use a computer to create a statistical control chart.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-04	Introduction to SPC - In earlier Modules you learned about measurement and issues that affect measurement accuracy. In this Module, you will learn the basics of statistical process control and how to determine if a process is operating correctly (producing good parts). You will do this by creating and then analyzing measurement data in special graphs called histograms.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-05	Control Chart Operation - This Module is part of a 2-Module series that will introduce you to control charts. In this Module you are going to learn how control charts are used and how to record data. In the next Module, you will learn how to analyze this data and set up a control chart. The control chart is the single most important quality tool used in industry. Operators, technicians, and engineers use this chart every day in industries throughout the world.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-06	Control Chart Analysis - In this Module, you are going to continue your study of control charts by learning how to construct and analyze them. These are tasks that both technicians and engineers perform every day in industries throughout the world.	\$10.00	20.00%	\$8.00	Quality

W-11105-AA-07	SPC Problem Solving - In earlier Modules you learned how to measure, collect, and display quality data about a process. The goal of these activities is to identify problems in your process that need to be solved. In some cases, the way you display the data will help you identify possible reasons for the problem but they don't do the entire job of identifying the exact source of the problem. This Module will teach you some techniques for finding the source of the problem. These include cause and effect charts and brainstorming. In some cases, a defect could be caused by more than one source. To decide which source to deal with first, you will also learn in this Module how to construct and analyze a Pareto chart.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-08	Geometric Dimensioning and Tolerancing - In the previous Modules you learned how to use measuring tools to determine the dimensions of various features of parts. This is the first step of learning quality control. In this Module you are going to begin learning about the next step of quality control, which is how to determine whether or not the parts produced by the manufacturing process have acceptable dimensions. This is called tolerancing. This Module will teach you two tolerancing methods: conventional and geometric dimensioning and tolerancing (GD&T). Each method has its own applications.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-09	Location Tolerances - The control of the locations of part features is a major objective in manufacturing, because almost all parts require one or more features to be precisely located in order for the part to perform its function. Inspecting the locations of these features is a common task. In this MODULE you will learn how to interpret the tolerances of locations and inspect them. For a large percentage of parts, it is very important to control the location of holes during the manufacturing process. If the holes are not drilled in the proper locations, the two parts to be assembled will not fit together. This includes parts that are assembled using bolts, screws, rivets, pins, and even snaps. Examples include: refrigerators, stereo components, and car engines. Location tolerances is an area where GD&T has a tremendous advantage over the plus and minus tolerancing techniques you used in the previous Module. If you learn how to use GD&T techniques for position tolerances you will have learned a skill that industry needs now.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-10	Orientation Tolerances - In this Module, you are going to learn how to specify and measure two types of orientation tolerances: perpendicularity and parallelism. Both of these tolerances are important because they affect how parts fit together. To do this, you will learn how to use the modular gage to measure length of rectangular parts (segment 1) and how to use a free-standing indicator.	\$10.00	20.00%	\$8.00	Quality
W-11105-AA-11	Form Tolerances - In this Module, you are going to learn about a new group of geometric tolerances called form tolerances. In an earlier Module, you learned that form tolerances control the shape of the part. A part's shape will control not only its ability to fit into an assembly but also its performance if it is a part that moves in a machine. An example is a rotating shaft.	\$10.00	20.00%	\$8.00	Quality
W-11106A-XX-01	Band Saw Operation - This Module is going to teach you how to safely operate the power band saw. The band saw is used to cut off raw material into shorter lengths that can be used in the manufacturing process. It is found in every manufacturing plant and is the first machine you would be assigned to operate if you were hired at a machine shop. The power band saw is the most basic of the machines you will learn to use, but it does require that you learn to use correct procedures. In this Module, you will start with learning the parts and controls of the band saw, basic operation and safety procedures. Then you will operate the band saw to create a part.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-05	Introduction to the Drill Press - This Module is going to teach you how to safely operate a very versatile manufacturing tool machine, the drill press. The drill press is used to create holes. This machine is found in every manufacturing plant and tool shop. It is a relatively easy machine to learn to operate. Yet, it can be used to perform complex tasks that require a great deal of skill. You will be given step-by-step instructions that will teach you some of the skills desired by employers for entry level positions.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-06	Drill Press Operations - In this Module, you will continue using the drill press to create various types of holes used in the manufacturing environment. These include the countersink, counterbore, reamed, and tapped holes. These operations will be performed on the drill specimen you worked with in the previous Module.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-07	Introduction to Manufacturing Hand Tools - In this Module, you will learn how to use two important hand tools: the hacksaw and the file. These tools will help get you started on a project with which you will work over the next few Modules: a paper clip holder. In addition, you will learn a technique for applying layout marks to round stock.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-08	Introduction to the Manual Milling Machine - This Module will teach you how to operate the milling machine. The milling machine is a very flexible machine tool that is used extensively in the machine shop. In this Module you will learn how a milling machine works, milling machine safety, and basic milling operations. Also in the Module, you will learn how to perform a facing operation to achieve high dimensional accuracy on the parts you create.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-09	Milling Processes - This Module covers additional procedures used in the operation of the milling machine. The skills you acquire in this Module will enable you to better understand the versatility of the milling machine. As you learn these skills, you will continue working with the paper clip holder project you started in the previous Module.	\$10.00	20.00%	\$8.00	Machine Tools

W-11106A-XX-10	Introduction to the Manual Lathe - The lathe is a type of machine tool that is used for machining round parts. This Module is part of a three-Module series covering the operation of the manual lathe. In this first Module, you will begin by learning about basic lathe operation and safety. The next two Modules will continue your study by learning how to perform other common lathe operations. In this Module, you will begin work on a new project that will carry through this three-Module series. You will manufacture a shaft having various features created using a lathe. You will also create an end cap which will attach to the end of the shaft you create. You will learn more about this project as you work through the Modules. The lathe is the most complicated machine you will use in this module. However, it is easy to learn if its operation is broken down into smaller steps. This three-Module series will do just that.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-11	Turning Operations - This Module is the second part of a three-Module series that covers the manual lathe. In this Module, you will continue your work on the shaft project by learning how to reduce the diameter of a part to a certain size with a smooth finish. After you complete this Module, you will have the skills needed to learn more advanced turning operations that are covered in the next Module.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106A-XX-12	Lathe Operations - In the previous two Modules, you learned the basic skills needed to operate the lathe. As you learned these basic skills, you started a project to create a shaft. In this Module, you will learn additional skills that will allow you to complete the shaft project. You will also learn skills that will enable you to create an end cap that fits on the end of the shaft. These basic skills include special turning operations, such as chamfering and drilling.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106B-DA-02	Introduction to CNC Mill Programming - This Module covers how to operate a CNC milling machine and how to develop a basic program that will run the machine.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106B-DA-03	Basic CNC Mill Programming - Creating a precision part with a CNC mill requires an efficient CNC program, proper tooling, and accurate PRZ location. Parts made on CNC mills often receive tight tolerances that can not be met by using a manual mill. CNC machines can be accurate to within 0.01 mm (0.0005"), but without a proper setup, the finished part dimensions will still be wrong. This Module will teach you the basic fundamentals of CNC mill programming, which include: linear interpolation, startup and shutdown blocks, tooling selection, and accurate PRZ location.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106B-DA-04	Circular Interpolation - Programming straight lines is only the beginning of a good CNC program. Almost every part made on a CNC machine will have some form of arc or circle on it, and these are programmed differently than linear interpolations. In this Module, you will be introduced to circular interpolation commands, which are used to make arcs and circles, as well as other CNC commands that will help to expand your CNC knowledge. Although you will learn the programming syntax specifically for the Denford CNC Mill, with only minor changes, the same commands and codes are applicable on most other brands of CNC Mill.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106C-AA-02	Introduction to CNC Mill Programming - In this Module, you are going to learn how to operate a CNC milling machine and to develop a basic program that will run the machine.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106C-AA-03	Circular Interpolation - Programming straight lines is only the beginning of a good CNC program. Virtually every part made on a CNC machine will have some form of arc or circle on it, and these are programmed differently than linear interpolations. In this Module, you will be introduced to circular interpolation commands, which are used to make arcs and circles, as well as other CNC commands that will help to expand your CNC knowledge. Although you will learn the programming syntax specifically for the proLIGHT CNC Mill, with only minor changes, the same commands and codes are applicable on most other brands of CNC Mill.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106C-AA-04	CNC Mill Setup and Tooling - When working in a CNC machining environment, programming is only part of the process. Tooling must be correctly selected and installed. Parts made on CNC machines will often have tight tolerances which can not be met using manual operations. CNC machines can be accurate to within 0.01 mm (0.0005"), but without a proper setup, the finished part dimensions will still be wrong. This Module will teach you the fundamentals of CNC mill setup, which include: tooling selection and mounting, accurate PRZ location, and the fundamentals behind performing a production run.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106D-DA-02	Introduction to CNC Mill Programming - This Module covers how to operate a CNC milling machine and how to develop a basic program that will run the machine.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106D-DA-03	Basic CNC Mill Programming - Creating a precision part with a CNC mill requires an efficient CNC program, proper tooling, and accurate PRZ location. Parts made on CNC mills often receive tight tolerances that can not be met by using a manual mill. CNC machines can be accurate to within 0.01 mm (0.0005"), but without a proper setup, the finished part dimensions will still be wrong. This Module will teach you the basic fundamentals of CNC mill programming, which include: linear interpolation, startup and shutdown blocks, tooling selection, and accurate PRZ location.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106D-DA-04	Circular Interpolation - Programming straight lines is only the beginning of a good CNC program. Almost every part made on a CNC machine will have some form of arc or circle on it, and these are programmed differently than linear interpolations. In this Module, you will be introduced to circular interpolation commands, which are used to make arcs and circles, as well as other CNC commands that will help to expand your CNC knowledge. Although you will learn the programming syntax specifically for the Denford CNC Mill, with only minor changes, the same commands and codes are applicable on most other brands of CNC Mill.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106H-BB-02	Introduction to CNC Mill Programming - This Module covers how to operate a CNC milling machine and how to develop a basic program that will run the machine.	\$10.00	20.00%	\$8.00	Machine Tools

W-11106H-BB-03	Circular Interpolation - Programming straight lines is only the beginning of a good CNC program. Almost every part made on a CNC machine will have some form of arc or circle on it, and these are programmed differently than linear interpolations. This Module introduces circular interpolation commands, which are used to make arcs and circles, as well as other CNC commands that will help to expand your CNC knowledge. Although you will learn the programming syntax specifically for the Emco CNC Mill, with only minor changes, the same commands and codes are applicable on most other brands of CNC Mill.	\$10.00	20.00%	\$8.00	Machine Tools
W-11106H-BB-04	CNC Mill Setup and Tooling - When working in a CNC machining environment, programming is only part of the process. Tooling must be correctly selected and installed. Parts made on CNC machines will often have tight tolerances which can not be met using manual operations. CNC machines can be accurate to within 0.01 mm (0.0005"), but without a proper setup, the finished part dimensions will still be wrong. This Module covers the fundamentals of CNC mill setup, which include: tooling selection and mounting, accurate PRZ location, and the fundamentals behind performing a production run.	\$10.00	20.00%	\$8.00	Machine Tools
W-11204-CX-01	Concepts of Design - Product design is a very important step in the manufacturing process because 85% of the cost of the product is determined by the way it is designed. In this Module, you will learn about the technologies that designers use to develop products that have the lowest possible cost and meet the functions specified by marketing.	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-02	Precision Part Design - In this Module, you will learn the basics of precision part design. You will learn how to design individual components and an overall system that will consist of several components that must fit together and function with precision. This Module is the first in a series of six LAPs that will lead you through the manufacture of a gearbox. The main objective of this and following LAPs is to give you the skills that can be applied to other projects and not just the gearbox which you will create. These skills are applicable to any number of applications. The following table shows an overview of the steps and the LAPs in which you will create the gearbox. When you complete MP2, Module 4 you will have produced a precision-made gearbox.	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-03	Process Design - Designing a process to manufacture a product is as important as the design of the product itself. In this Module, you are going to design a manufacturing process and learn how to organize the data so that you can determine the cost of the product and communicate to the manufacturing department the information they need to make the product. In the previous Module in this module, you designed a gearbox. In this Module, you will continue working on the gearbox project by designing the manufacturing process to make the gearbox. This includes creating a bill of materials, process chart, technical drawings, and other material necessary to set up the manufacturing process. This is the final step before you are ready to start creating programs to make the gearbox. The following chart shows an overview of the complete gearbox design process.	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-04	Contour CAM Toolpath - The contour toolpath is the most commonly used toolpath in CAM software. In this Module, you will learn how to use it in a variety of applications. This toolpath will be used in a later Module to create part of the CNC program to create a gearbox and a tensile test specimen. Also, you will learn about two important CAM software utilities: cycle time estimation and tool libraries. By learning how to estimate cycle time you will be able to determine the machining cost of a part. During this Module you will not actually work on the gearbox itself. You will only learn skills you will need in the next Module. This is the third in a series of LAPs covering the gearbox project. When you complete the series, shown in the table below, you will have produced a precision-made gearbox.	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-05	CAM Parameters - While CAM software is very versatile, this does not necessarily make it difficult to use. Many of the features included in CAM software are designed to make using it easier. The parameter pages in CAM software packages control all of the different settings for a toolpath; every toolpath requires some information from the parameter pages. Some examples of parameter page values are the spindle speed, the tool size, and the depth of cut. In this Module, you will learn how CAM software's parameter pages can fine-tune a toolpath. You will work on two different parts in this Module: a tensile specimen which can be used in the Quality Control module, and a gearbox that you will manufacture in a later Module once you have mastered all the necessary skills. At this time, you have designed your gearbox and the process that will be used to manufacture it. You have also created a tool library which contains descriptions of each tool required by the manufacturing process. The next step is to import the CAD drawing into the CAM software and start creating the programs needed for the CNC machine. The programs created in this Module will cut a step on the gearbox and	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-06	Making Parts With CAD/CAM - The contour toolpath is not restricted to cutting flat slots, letters, and the edges of parts. It is also possible to cut three-dimensional contours or contours at different depths. While the contour toolpath is the most basic and the most versatile of all CAM toolpaths, the contour toolpath is only the first of a number of toolpaths you will need to learn in order to use CAD/CAM software well. Sometimes, holes need to be drilled or pockets need to be cut; the contour toolpath is not effective at making these types of cuts. In this Module, you will learn to use the contour toolpath to make more complex types of cuts. You will also learn two other toolpaths: drill and pocket. At the completion of this Module you will have created all of the CNC programs needed to create the gearbox. You will have everything necessary to manufacture a precision gearbox. You have progressed from a concept of a design to working drawings, process plan, tooling, and programs. Your progress can be seen in the following table.	\$10.00	20.00%	\$8.00	Design Processes
W-11204-CX-07	Intermediate Level CAM Toolpaths - As you become more skilled at using CAM software, the numbers and types of parts which can be made increases. In this Module, you will learn two new toolpaths and see applications where these toolpaths could be used. In addition, when many toolpaths are available, selecting the correct one to use can become difficult. In this Module, you will also learn how to select the correct toolpath or toolpaths to use on complex parts.	\$10.00	20.00%	\$8.00	Design Processes

W-11204-CX-08	CAM for Lathe - In this Module, you are going to use a CAM software package to create a program that can be run on a CNC lathe to create a part. The software you will be using in this Module is a version of Mastercam that is designed with specific commands for the lathe. Most of the general commands for tasks such as editing are the same as you used with the mill version. The part you will be making in this Module is a chess piece called a pawn.	\$10.00	20.00%	\$8.00	Design Processes
W-11206A-XX-01	Speeds and Feeds - As you begin writing your own CNC programs, you will need to determine what speeds and feeds to use to ensure long tool life and a good surface finish. In this Module, you will learn how to calculate the speeds and feeds for CNC operations. In addition, these calculations also apply to machining operations on manual machines, such as the drill press, manual milling machine, and lathe. By understanding how to determine the correct speeds and feeds to use, you will be one step closer to being an excellent machinist.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206A-XX-04	Fixture Design - Work holding is an important consideration in any manufacturing operation. In this Module, you will learn how to design and use a fixture to machine parts using CNC machines. Specifically, you will design a fixture to create your gearbox.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206B-DA-02	CNC Mill Canned Cycles - In this Module you will learn how canned cycles and subprograms are used to simplify CNC programs. These techniques will allow you to create programs much faster. You will work with sample parts which will help you see the effectiveness of canned cycles and subprograms.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206B-DA-03	CNC Mill Cutter Compensation - As you begin to program complex shapes for machining on the CNC machine, it becomes important to learn ways in which to simplify the program. In this Module, you will learn how to use cutter compensation, a feature in many CNC machines which can greatly simplify CNC programs. In addition, you will learn another feature called mirroring which will allow you to simplify certain programs even further. You will use it in this Module to create a playing card.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206B-DA-05	Introduction to CNC Lathe Programming - In this Module, you will be introduced to CNC lathe operation and programming. You will learn the basic components of a CNC lathe. Also, you will use basic G and M-codes to write a program to reduce the diameter of a shaft using several passes for each diameter reduction. You will then simulate the program and turn the part on the CNC lathe. Although you will learn the programming syntax specifically for the Denford CNC lathe, with only minor changes, the same commands and codes are applicable on most other brands of CNC lathes.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206B-DA-06	Lathe Circular Interpolation - In this Module, you will be introduced to the circular interpolation commands for a CNC lathe, which work similarly to the circular interpolation commands on a CNC mill. However, there are some differences, as you will see. Your project will be to write a program to create a part with a specific fillet, based on a part drawing. As a part of this procedure, you will learn how a CAD package is used to help determine exact coordinates for tool movement. You will then enter, simulate, and run the program to produce the part. Although you will learn the programming syntax specifically for the Denford Novaturn lathe, with minor changes, the same commands and codes are applicable on most other brands of CNC lathe.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206D-DA-02	CNC Mill Canned Cycles - In this Module you will learn how canned cycles and subprograms are used to simplify CNC programs. These techniques will allow you to create programs much faster. You will work with sample parts which will help you see the effectiveness of canned cycles and subprograms.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206D-DA-03	CNC Mill Cutter Compensation - As you begin to program complex shapes for machining on the CNC machine, it becomes important to learn ways in which to simplify the program. In this Module, you will learn how to use cutter compensation, a feature in many CNC machines which can greatly simplify CNC programs. In addition, you will learn another feature called mirroring which will allow you to simplify certain programs even further. You will use it in this Module to create a playing card.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206D-DA-05	Introduction to CNC Lathe Programming - In this Module, you will be introduced to CNC lathe operation and programming. You will learn the basic components of a CNC lathe. Also, you will use basic G and M-codes to write a program to reduce the diameter of a shaft using several passes for each diameter reduction. You will then simulate the program and turn the part on the CNC lathe. Although you will learn the programming syntax specifically for the Denford CNC lathe, with only minor changes, the same commands and codes are applicable on most other brands of CNC lathes.	\$10.00	20.00%	\$8.00	Machine Tools
W-11206D-DA-06	Lathe Circular Interpolation - In this Module, you will be introduced to the circular interpolation commands for a CNC lathe, which work similarly to the circular interpolation commands on a CNC mill. However, there are some differences, as you will see. Your project will be to write a program to create a part with a specific fillet, based on a part drawing. As a part of this procedure, you will learn how a CAD package is used to help determine exact coordinates for tool movement. You will then enter, simulate, and run the program to produce the part. Although you will learn the programming syntax specifically for the Denford Microturn lathe, with minor changes, the same commands and codes are applicable on most other brands of CNC lathe.	\$10.00	20.00%	\$8.00	Machine Tools
W-11306-XA-01	Introduction to Injection Molding Operations - Plastics play a large role in our lives. Nearly every product we use contains plastics. Televisions, automobiles, computers and thousands of other products have plastic components. As a result, the plastics industry is very large and employs many workers. In this Module, you will learn about plastics and the processes used to create plastics parts. In this first Module, you will learn the injection molding process. In later Modules, you will learn about blow molding, extrusion, and plastics chemistry.	\$10.00	20.00%	\$8.00	Plastics

W-11306-XA-02	Injection Molding Operations - In this Module you will learn about special features used on plastics parts, such as about inserts, threads, hinges, and snap fits. All of these features make plastics parts more useful. You will also learn how to purge a plastics machine. Purging gives you the ability to change from one plastics material to another.	\$10.00	20.00%	\$8.00	Plastics
W-11306-XA-03	Plastics: Chemistry and Properties - As you know, there are many types of plastics, and their properties can be vastly different. One plastics is hard and brittle while another is soft and flexible. The differences between plastics materials goes right down to the atomic level. Differences in chemical composition and atomic structure will influence the characteristics of the plastics material. In this Module you will be introduced to the molecular structure of plastics, and see how plastics materials are formed. You will learn how atoms and molecules are combined and held together to form different types of polymers. You will also create your own plastics material by combining different chemicals. This knowledge will help you understand the properties of plastics. You will also learn various properties and characteristics of plastics that will help you understand how a material is likely to behave when injected into a mold. Understanding the material used in a plastics molding operation will increase your ability to correctly setup and maintain the molding process.	\$10.00	20.00%	\$8.00	Plastics
W-11306-XA-04	Introduction to Blow Molding Operations - In this Module you will learn the operation of blow molding. This is another type of molding plastics parts. It is important to learn as many processes in the plastics field as you can. It is common for companies to have several different types of plastics processing operations at one facility. Therefore, your ability to understand each process will help you in meeting the needs of an employer.	\$10.00	20.00%	\$8.00	Plastics
W-11306-XA-05	Introduction to Extrusion Operations - In this Module you will learn the operation of extrusion. This is another method by which plastics parts can be created. It differs from injection molding and blow molding in that it is not a molding operation. Both injection molding and blow molding have a cavity inside which the plastics is formed. In extrusion, there is no cavity, but instead an orifice through which all the plastics is pushed.	\$10.00	20.00%	\$8.00	Plastics
W-11604-XA-01	Introduction to Thermal Systems - Thermal systems play a key role in industry and the quality of human life. Many of the conveniences that we enjoy in modern society can be attributed to our ability to generate "hot" and "cold". In fact, it is hard to imagine life without air conditioning systems to keep us comfortable on the hottest days and refrigeration systems to preserve food. Thermal systems also involve heating and storing this heat during the cold months. In this Module, you will be introduced to thermal system function and to the concepts of temperature, pressure, and thermal expansion. These concepts are very necessary in order to fully understand thermal system design and operation.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11604-XA-02	Thermal Energy and Heat Transfer - A firm grasp of heat, energy, work, and refrigerant properties is required to fully understand thermal system operation. While these terms are used loosely in our everyday language, they have very precise meanings in the engineering world. In this Module, you will be introduced to thermodynamics, which is the science that describes thermal systems. You will also learn about the fundamentals of thermal energy and heat transfer. As you will see, thermodynamics applies not only to thermal systems but has numerous applications to life in general.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11604-XA-03	Thermodynamic Laws and Properties - This Module introduces the fundamental laws of thermodynamics. These laws were discovered through meticulous experimentation in the 18th and 19th centuries. They give engineers the tools they need to understand, design, and test thermal systems. The thermodynamic laws are referred to as laws because they have stood up against countless experiments and have been found to hold true. It is therefore more important to grasp the concept of what these laws tell us rather than simply memorize the equations.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11604-XA-04	Refrigeration Thermodynamics - We have now come to the point where we can introduce the thermodynamics that allows thermal systems to operate. In this Module, you will be introduced to thermodynamic cycles, heat transfer, refrigeration science, and an introduction to refrigerants. These concepts are at the heart of thermal system design and performance.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11604-XA-05	Refrigeration/Heat Pump Operation - At this point, you have learned the fundamentals of heat, work, gas laws, thermodynamic laws and cycles. You should now have all the basic tools needed to fully analyze vapor-compression refrigeration and heat pump cycles. In this Module, you will study vapor-compression system components in more detail. You will also learn about heat duty and be introduced heat pump system.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11605-XA-01	Thermal System Performance - In Thermal Systems 1 you learned the principles and theories of thermal systems. Thermal Systems 2 will build on that knowledge, incorporating it with real world applications such as heating and cooling systems, system performance, insulation, and humidity. This will give you a better understanding of how these items, which are a part of your everyday life, can be modified to improve human comfort conditions. In this Module you will learn how to calculate the efficiency of a thermal system and what factors affect that efficiency. You will also become familiar with the concept of heat loads and how they affect the thermal system as well as how different components adapt to heat load changes. You will then begin to understand how system efficiency can be improved to save money on costly energy bills and save valuable natural resources.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11605-XA-02	Insulation - Insulation is an integral part of any thermal system for maintaining the desired temperature. In this Module you will learn how to use insulation to improve the efficiency of a thermal system.	\$10.00	20.00%	\$8.00	Thermal Systems

W-11605-XA-03	Psychrometrics - Humidity changes more than any other atmospheric property and is a major factor in weather and climate. While not much can be done about the outside humidity, the amount of humidity inside a space can be controlled. Psychrometrics is the science of evaluating and controlling the air/water vapor mixture in an enclosed environment. This is vital to maintaining human comfort conditions inside buildings. In this Module you will learn how to measure and control humidity as well as how humidity affects the living environment.	\$10.00	20.00%	\$8.00	Thermal Systems
W-11605-XA-04	Residential Heating and Cooling - Heating and cooling systems make the indoor climate comfortable for the occupants. In this LAP you will learn about the components involved in maintaining a comfortable environment in the home. You will also learn what is involved in designing and sizing these systems. This knowledge will give you a better understanding of how all of the systems work together.	\$10.00	20.00%	\$8.00	Thermal Systems
W-12243-XX-01	Introduction to the Manual Lathe - The lathe is a type of machine tool that is used for machining round parts. This Module is part of a three-Module series covering the operation of the manual lathe. In this first Module, you will begin by learning about basic lathe operation and safety. The next two Modules will continue your study by learning how to perform other common lathe operations. In this Module, you will begin work on a new project that will carry through this three-Module series. You will manufacture a shaft having various features created using a lathe. You will also create an end cap which will attach to the end of the shaft you create. You will learn more about this project as you work through the Modules. The lathe is the most complicated machine you will use in this module. However, it is easy to learn if its operation is broken down into smaller steps. This three-Module series will do just that.	\$10.00	20.00%	\$8.00	Machine Tools
W-12243-XX-02	Turning Operations - This Module is the second part of a three-Module series that covers the manual lathe. In this Module, you will continue your work on the shaft project by learning how to reduce the diameter of a part to a certain size with a smooth finish. After you complete this Module, you will have the skills needed to learn more advanced turning operations that are covered in the next Module.	\$10.00	20.00%	\$8.00	Machine Tools
W-12243-XX-03	Lathe Operations - In the previous two Modules, you learned the basic skills needed to operate the lathe. As you learned these basic skills, you started a project to create a shaft. In this Module, you will learn additional skills that will allow you to complete the shaft project. You will also learn skills that will enable you to create an end cap that fits on the end of the shaft. These basic skills include special turning operations, such as chamfering and drilling.	\$10.00	20.00%	\$8.00	Machine Tools
W-17401-BE-01	Introduction to Electric Motor Control - This course can contain as little as 10 Modules or as many as 20 Modules. The first 10 Modules of this series cover the basic motor control topics and require only the base 85-MT5 system. Modules 11-20 cover more advanced topics and require different add-on packages to the 85-MT5. Each Module (11-20) associated with an add-on package will identify which package is required. In this course, you are going to study the various devices and circuits used to control electric motors, in most cases three-phase motors. As a first step, this Module will teach you the basic operation of the three-phase motor, its power supply circuitry, and safety practices.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-02	Manual Motor Control and Overload Protection - Motor control circuits are designed to perform a variety of functions including starting, stopping, reversing, and speed control. There are several different control devices that are used in electric motor control. This Module covers which components are required to satisfy the most basic safety requirements for motor control circuits. It also covers manual control and overload protection of electric motors.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-03	Control Transformers - For safety reasons, the voltage that is supplied to the control components of a motor control circuit is often lower than the voltage supplied to the motor itself. In many cases, the controls are powered with single-phase power even if the motor is receiving three-phase power. A special type of transformer called a control transformer is used to convert the three-phase line voltage to a lower single-phase voltage that can be used safely by the control devices. This Module covers the construction and operation of control transformers. It also covers how to select the appropriate transformer for an application and install a control transformer to provide power for a control circuit.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-04	Control Ladder Logic - This Module covers the fundamentals of electrical control circuits. This includes learning the function and operation of some of the basic components of an electrical circuit and how they are connected to perform various control logic functions. In addition, this Module covers how to read and interpret a ladder diagram, which is a common type of electrical schematic. Ladder or line diagrams make it easier to understand how an electrical control circuit works.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-05	Control Relays and Motor Starters - This Module covers how control relays and motor starters can be used to control the start and stop of electric motors. As part of this, you will learn how the sixth element of logic, memory, works. The memory logic function is a very important concept because it is the building block for creating multiple-step sequence control circuits.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-06	Introduction to Troubleshooting - As machines become more complex, the number of things that can cause a machine malfunction also increases. This makes the process of finding the causes of problems more difficult. This process, called troubleshooting, is today one of the most challenging parts of both the jobs of engineers and technicians. This Module begins your study of troubleshooting. To do this, you are going to use the troubleshooting feature available with the 85-MT5 Electric Motor Control Learning System, which allows you to insert faults into the system using a computer controlled unit called the 890-FTS-1 Troubleshooting System. Or, if you do not have the troubleshooting unit, you can manually insert faults using special fault plugs. This Module covers how to perform tests on the components whose operation you have studied in previous Modules. The next Module covers how to troubleshoot entire circuits.	\$10.00	20.00%	\$8.00	Electric Motor Control

W-17401-BE-07	Systems Troubleshooting - The previous Module covered how to perform out-of-circuit tests on various components to determine whether or not they are working correctly. However, before a troubleshooter starts to remove components from a circuit, he/she should first perform a series of tests on the components while they are still in the circuit to determine which one is most likely bad. This process is called systems level troubleshooting. This Module covers a number of systems level troubleshooting methods, which allow you to troubleshoot circuits more quickly. However, before you learn about these troubleshooting methods, you will learn how to select and use some of the different test instruments used to perform these tests.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-08	Reversing Motor Control - Many motor applications require that the motor be reversed at times. This Module covers the most common method used to reverse an electric motor as well as the most common methods used to provide safety when reversing a motor. Also, many machines allow you to select different modes of operation. This Module also covers the different modes and the controls used to select the different.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-09	Automatic Input Devices 1 - In order to provide automatic operation in control circuits, automatic input devices are needed to turn the outputs on and off based on certain conditions. This allows the control circuit to continue to operate without the constant presence of an operator. This Module covers some of the basic automatic input devices used in motor control. It covers how they operate and where they are commonly used. It also covers how they are sometimes used to control a sequence of events.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17401-BE-10	Basic Timer Control: On-Delay and Off-Delay - This Module covers the basic function and operation of a time-delay relay. You will learn about and use two types of timers, on-delay and off-delay. Both on-delay and off-delay timers are useful in motor control circuits. The idea of using time as a control device is not a new one. Time-control is the most common method of sequencing the events in our lives. Alarm clocks, traffic lights, and intermittent windshield wipers are all everyday objects which use time control.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17402-BE-11	Braking Methods - This Module, and the ones that follow (11-20), continue the Electric Motor Control series by covering more advanced motor control topics. Instead of letting motors coast to a stop, many applications require a motor to stop (brake) very quickly, especially in an emergency situation. This Module covers four basic categories of motor braking: plugging, electromagnetic braking, DC injection, and dynamic braking.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17403-BE-12	Reduced Voltage Starting Circuits - In earlier Modules you learned how to start motors using full voltage motor starters (starters that apply the full line voltage at the motor leads). For many applications, especially those involving small horsepower motors, this is the least expensive and most efficient way of starting an electrical motor. However, for larger motors, the power cost of full voltage starting can become very expensive. This Module covers how reduced voltage starting is used to reduce this power cost.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17403-BE-13	Power Generation and Distribution - The electricity that is used in your home and workplace is generated in a power plant. It is then sent to various sub-stations, via power lines. These substations distribute the electricity to all of their customers. This Module covers the methods used to generate and distribute AC power. Not only is electrical power distributed from power plants to their customers, electricity must also be distributed throughout the customer's facility, through the use of transformer banks. The electrical configuration of the transformer banks provide different voltage levels to drive the machinery and to provide control. This Module introduces you to four different types of transformer distribution banks.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17404-BE-14	Electronic Sensors (85-MT5-D) - This Module covers electronic sensors and how they are used in motor control circuits. Sensors provide the motor control circuit with automatic input devices that can be used in applications where non-touch sensing is needed.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17405-BE-15	Timers and Counters - This Module covers two more types of timers: one-shot timers and repeat cycle timers. It also covers counters. The counter is similar to the timer relay except that it changes the state of its contacts after a certain count is reached instead of after a time delay.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17411-BE-16	Introduction to Variable Frequency AC Drives - This Module begins a series of 4 Modules that cover the basic function, operation, and application of variable frequency AC drives. Variable frequency AC drives have been around for several years. However, only in recent years have they become widely used in applications that were traditionally reserved for DC or hydraulic drive systems. Recent advances on the electronic side (faster microprocessor speeds, more reliable power switching devices, and better control algorithms) have reduced the cost of variable speed drives and enhanced their performance. This Module covers the basic fundamentals of how a typical AC drive operates. It also covers how to wire and program a variable frequency drive to operate with external controls.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17411-BE-17	Variable Frequency AC Drives - Speed and Torque Control - This Module is the second Module dealing with variable frequency drives. One of the most appealing features of a variable frequency drive is that it can vary the speed of an AC motor. However, with these enhanced speed control capabilities come some tradeoffs, usually lower torque. This Module covers how motor speed is controlled with a variable frequency drive. It also covers how a motor can be operated above its base speed and how to compensate for some of the losses in torque.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17411-BE-18	Variable Frequency AC Drives - Accel./Decel. and Braking - This is the third Module in the series covering AC variable speed drives. Most variable AC speed drives provide excellent acceleration and deceleration control, as well as various braking methods. This Module covers some of the more common acceleration and deceleration methods used with variable frequency AC drives. It also covers how braking is accomplished with a variable frequency drive.	\$10.00	20.00%	\$8.00	Electric Motor Control

W-17411-BE-19	Variable Frequency AC Drives - Fault Diagnostics and T-shooting - This is the final Module in the series covering variable frequency drives. This Module covers how to troubleshoot circuits that include variable frequency drives. Because many variable frequency drives are programmable, malfunctions may not only be caused by mechanical or electrical failures, but also by a parameter that has been incorrectly programmed. This can make the troubleshooting task a bit more difficult and time consuming. However, many variable frequency drives also have built-in fault detection capabilities. Such capabilities make these variable frequency drives even more desirable.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17412-BE-20	SCR Motor Control (85-MT5-F) - This is the final Module in the Electric Motor Control series and covers the topic of DC Motor Speed Control. DC motor speed can easily be varied by using variable resistors to control motor voltage. While this is a simple method, it is not very efficient because the power is being wasted by the resistor. Another method of speed control, which is more efficient, uses a type of semiconductor called a thyristor. Thyristor is the Greek word for door. A thyristor gets its name because it controls voltage by opening and closing (like a door). This Module covers a type of thyristor called an SCR (Silicon Controlled Rectifier), which is often used to control motor speed.	\$10.00	20.00%	\$8.00	Electric Motor Control
W-17420-BA-01	Introduction to AC Motion Control - Motion control has been around for many years and has expanded in scope as technology has improved. Motion control can be as simple as opening or closing a valve or as complex as controlling multiple axes on a CNC machine. Early in the 20th century, most motion control was accomplished with mechanical drive devices such as gears and clutches. However, electronic drives can now achieve very precise motion control because of major improvements in electronic technology during the last 30-40 years. DC drives have been around for many years and are still widely used in certain applications. However, with improvements in AC drive technology, AC drives are quickly replacing DC drives in many applications. In this Module, and the ones that follow, you will learn about the operation of different types of AC drives, their applications, and how to troubleshoot them.	\$10.00	20.00%	\$8.00	Electronic Drives
W-17420-BA-02	AC Vector (Spindle) Drives - Over the last several years, the motor control provided by AC drives has improved tremendously. The type of AC drive that provides the best speed and torque control over a wide operating range is the vector drive. This makes the vector drive a very popular choice in many different applications. In this Module, you will learn about the construction and operation of a vector drive. In addition, you will learn about some of the applications of vector drives.	\$10.00	20.00%	\$8.00	Electronic Drives
W-17420-BA-03	AC Axis Drives - In the previous Module you learned about one type of AC drive, a vector drive. You learned about the complex scheme that vector drives use to control the output current, and therefore torque. You also learned that vector drives are often used in machine spindle applications. In this Module, you will learn about another type of AC drive, the AC servo (axis) drive. AC axis drives have many similarities to vector drives in construction and output produced. However, axis drives include position feedback that is not present in vector drives. In addition, you will learn how an AC axis drive, along with a special brushless servomotor, can deliver excellent response, precise speed control, and good torque regulation.	\$10.00	20.00%	\$8.00	Electronic Drives
W-17420-BA-04	General-Purpose AC Drives - In this Module, you will be learning about less expensive drives that provide enough functions to make them useful in many common industrial applications. These drives fall into a broad category called General-Purpose AC Drive. To begin, you will learn about the operating fundamentals of general-purpose AC drives. This includes their basic function as well as their advantages over other types of AC drives in certain applications. You will also learn about the construction and operation of general-purpose AC drives. In addition, you will learn how general-purpose AC drives can be used to control the acceleration and deceleration of a motor as well as the different modes of acceleration/deceleration control. You will also learn how these drives are used to control the torque output of the motor. Finally, you will learn about the various stopping modes of which general-purpose drives are capable.	\$10.00	20.00%	\$8.00	Electronic Drives
W-17420-BA-05	AC Drive Troubleshooting - In the previous Modules, you learned about the function, construction, and operation of the basic types of AC drives. A proper understanding of the construction and operation of an AC drive is necessary to properly troubleshoot and repair a malfunctioning system. The ability to perform troubleshooting tasks is extremely important and valuable. A machine or system that is down is very costly. It is important to be able to quickly and accurately identify the problem. Once identified, you can correct the problem and get the system back on line. In this Module, you will learn to use your basic understanding of the various drives, along with documentation (schematic diagrams and troubleshooting charts) from the drive's manufacturer, and the proper test equipment to troubleshoot various AC drive systems.	\$10.00	20.00%	\$8.00	Electronic Drives
W-17451-XB-01	Introduction to Electrical Control Wiring - An electrician in an industrial setting is often called on to wire control panels and operator station panels on machines. There are many things that an electrician must know before beginning this task. For example, an electrician must be able to read and interpret electrical prints. An electrician must also be able to select and install terminal blocks in the panels. In addition, an electrician should be able to determine the number of wires that need to be run between the panels as well as what wire colors are needed. This Module covers how to do all of these things. Learning how to use an electrical print to determine these details will help you when you actually wire a circuit.	\$10.00	20.00%	\$8.00	Electricity
W-17451-XB-02	Electrical Control System Wiring - Wiring should be installed in an electrical panel in a neat and orderly manner, according to the electrical print. There are several practices that should be followed when installing wiring in an electrical panel that help ensure safety and make the troubleshooting process much easier. This Module covers how to properly install control wiring in an electrical panel. Topics include proper wire color coding, proper wire termination techniques, and proper wire bundling.	\$10.00	20.00%	\$8.00	Electricity
W-17471-XA-01	Introduction to Raceways - This Module is the first of a series that will teach you the knowledge and skills necessary to design, select and install industrial wiring systems. In this Module, you will learn about the different types of conduit and their application. In addition, you will learn to cut, couple and connect electrical metallic conduit (EMT).	\$10.00	20.00%	\$8.00	Electricity

W-17471-XA-02	Basic Conduit Bending - This is the second of a series Modules that teach the knowledge and skills necessary to design, select and install industrial wiring systems. In this Module, you will learn the skills and tools necessary to bend conduit. These skills are important to obtain a position in the exciting field of industrial maintenance.	\$10.00	20.00%	\$8.00	Electricity
W-17471-XA-03	Advanced Raceways - In the first two Modules of this series, you have been working with EMT conduit. Now you will begin working with intermediate metallic conduit (IMC), which is the type you would most likely see in most industrial applications. As you will see, there are some differences between working with EMT and IMC. In addition, you will be using flexible metal conduit called liquidtight.	\$10.00	20.00%	\$8.00	Electricity
W-17471-XA-04	Conductors, Disconnects, and Overcurrent Protection - There are many factors to be considered when installing a wiring system. Many of these factors are based on NEC requirements. Factors such as wire size, material, and insulation must be considered. In addition, the type and size of overcurrent protection must be selected, according to NEC requirements. In this Module, you will learn the factors that affect the selection of the conductors and overcurrent protection devices. This will allow you to be able to select the required conductors and protection for a variety of applications.	\$10.00	20.00%	\$8.00	Electricity
W-17471-XA-05	Conduit Sizing and Wire Pulling Techniques - A properly installed raceway is custom fitted to the type and number of conductors required by the application. It is the job of an electrician to be able to install such a raceway as well as "pull the conductors" once the raceway is complete. This LAP will teach you some of the basics in raceway component selection and wire pulling techniques. These are two very valuable skills for an industrial electrician.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-01	Basic Electrical Circuits - Electricity is used to perform tasks related to almost everything we do. In this unit, you are going to learn the fundamental concepts of electricity used in many applications, especially control systems. The specific skills you learn will enable you to perform basic electrical projects at home and on the job. These skills will also be applied in many other units including programmable controllers, electrical motor control, and electro- fluidpower. In this Module, you will learn how a basic electrical circuit works by setting up a number of circuits using the various components in the Amatrol T7017 AC/DC Electrical Learning System. This will also help you get more familiar with the operation of the trainer you will be using.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-02	Electrical Measurement - In this Module, you are going to learn how to perform basic measurements of voltage, resistance and current in series and parallel circuits. The skills you learn here will be used every time you troubleshoot or test an electrical circuit.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-03	Circuit Analysis - In the previous Module, you learned how current, resistance and voltage are affected by circuits with series and parallel loads. You did not, however, attempt to analyze the precise relationship between these three characteristics. In this Module, you will do just that through Ohm's Law and Kirchhoff's voltage and current laws. These laws are fundamental concepts used by every electrician, electronics technician, and electrical engineer. One application of these laws is to determine how much power is needed for a circuit. You will learn to do this calculation in this Module.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-04	Inductance and Capacitance - So far, the electrical circuits you have studied have only contained resistive-type load characteristics. In this Module, you will learn about two new types of load characteristics: inductance and capacitance. These two characteristics play an important role in many electrical systems you work with every day. Examples include: electric motors, power supplies, lighting systems, car ignitions, and flash cameras. In this Module, you will also learn about electromagnetism. Electromagnetism is an electrical principle that contributes to inductance. It is the principle that allows motors to turn and relays to operate. Before you study inductance, you must first understand electromagnetism.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-05	Combination Circuits - In this Module you are going to build on what you have learned about series circuits and parallel circuits in previous Modules by combining them into combination circuits. You will find that many of the circuits you see in industry, home, and commercial electrical systems are actually combination circuits. Combination circuits combine the desirable characteristics of series and parallel circuits.	\$10.00	20.00%	\$8.00	Electricity
W-B227-AB-06	Transformers - In a previous Module, you learned about the principle of inductance and its effects in AC circuits. In this Module, you learn how inductance is used to change AC voltages from one level to another. The device that produces this change is called a transformer. The transformer is one of the most commonly used inductive devices in electric power distribution. This Module will teach you how transformers work and how to select, connect, and troubleshoot them.	\$10.00	20.00%	\$8.00	Electricity
W-B408-AB-01	Introduction to Programmable Controllers - The Programmable Logic Controller (PLC) is a microprocessor-based controller designed to provide easily programmed control of almost any type of process. Its development is very important because the PLC has done for the shop floor what the personal computer has done for the office. This course will teach you how to design, program and operate the PLC to control a number of process applications used by industries all over the world. The skills you will learn are in high demand everywhere today. In this first Module you will learn about the basic operation of the PLC and how its programming language works. In the Module that follows, you will learn how to enter programs.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-02	Basic PLC Programming - In this Module, you will learn how to enter, edit, and store PLC programs using PLC software. You will also learn about the PLC's memory, how it is organized, and what types of numbering systems are commonly used with the PLC. All of these skills are important to be able to fully understand and operate the SLC 500.	\$10.00	20.00%	\$8.00	PLCs

W-B408-AB-03	PLC Motor Control - In the first three segments of this Module, you will learn how the PLC is programmed to control electric motor applications. To do this, you will learn about the sixth logic element, which is memory. The programs and instructions you will learn in this Module are not limited to motor control but are fundamental to all PLC programs. In the last segment, you will learn how to add comments to your PLC programs and how to copy and paste sections of your program.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-04	Discrete I/O Interfacing - The ability of a PLC to interface to many types of I/O devices and other controllers is one of its best advantages. Because there are many designs of products the PLC must interface to, there is not a standard method of wiring to these devices. Certain types of PLC I/O modules must be selected to work with certain kinds of I/O devices and the interface wiring can be different in each case. In this Module, you will learn how to interface a number of common I/O devices to the PLC and how to test this interfacing to make sure it is working.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-05	Event Sequencing - In this Module you will learn how to design and interpret PLC programs that control the sequence of operations of entire machines. This is an important topic because most PLC programs perform a sequence of some kind.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-06	Application Development - In the previous Module, you learned the basics of designing and interpreting PLC programs that control machine sequencing. Event sequencing programs, you may have noticed, can seem very complicated. In this Module, you will learn a step-by-step technique that makes reading and designing event sequencing programs much easier.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-07	PLC Timer Instructions - In this Module, you are going to learn about PLC timer instructions and their applications. PLC programs often use timers. An example is to sequence the events in a chemical mixing process.	\$10.00	20.00%	\$8.00	PLCs
W-B408-AB-08	PLC Counter Instructions - In this Module, you are going to learn how to use counter instructions and special functions that are used in PLC applications. Counters are important because they allow a PLC to keep track of production and other data as well as control functions that are based on counting. The special functions you will learn about in this Module are commonly used to do tasks in addition to making the machine perform its basic sequence.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-01	Introduction to Programmable Controllers - The Programmable Logic Controller (PLC) is a microprocessor-based controller designed to provide easily programmed control of almost any type of process. Its development is very important because the PLC has done for the shop floor what the personal computer has done for the office. This course will teach you how to design, program and operate the PLC to control a number of process applications used by industries all over the world. The skills you will learn are in high demand everywhere today. In this first Module you will learn about the basic operation of the PLC and how its programming language works. In the Module that follows, you will learn how to enter programs.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-02	Basic PLC Programming - In this Module, you will learn how to enter, edit, and store PLC programs using PLC software. You will also learn about the PLC's memory, how it is organized, and what types of numbering systems are commonly used with the PLC. All of these skills are important to be able to fully understand and operate the Allen-Bradley SLC 500.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-03	PLC Motor Control - In the first three segments of this Module, you will learn how the PLC is programmed to control electric motor applications. To do this, you will learn about the sixth logic element, which is memory. The programs and instructions you will learn in this Module are not limited to motor control but are fundamental to all PLC programs. In the last segment, you will learn how to add comments to your PLC programs and how to copy and paste sections of your program.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-04	Discrete I/O Interfacing - The ability of a PLC to interface to many types of I/O devices and other controllers is one of its best advantages. Because there are many products to which the PLC must interface, there is not a standard method of wiring to these devices. Certain types of PLC I/O modules must be selected to work with certain kinds of I/O devices and the interface wiring can be different in each case. In this Module, you will learn how to interface a number of common I/O devices to the PLC and how to test this interfacing to make sure it is working.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-05	Introduction to PLC Troubleshooting - As machines become more complex, troubleshooting malfunctions becomes more difficult. Today, troubleshooting is one of the most challenging skills for engineers and technicians alike. In this Module, you will begin your study of PLC troubleshooting. To do this you are going to use the troubleshooting feature of the 890-PEC Programmable Controller Training System, which allows you to insert faults into the system. In this Module, you will perform tests on the PLC components to learn where failures can occur and how to tell when a component is good or bad.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-06	PLC Systems Troubleshooting - In this Module you are going to learn a systematic method for troubleshooting the entire PLC system. This method will combine the troubleshooting skills for various PLC subsystems you learned in the previous Module with the processor troubleshooting skills you will learn in Segment 1 of this Module. The troubleshooting skills that you have learned so far, and will learn, will be applied in following Modules so that you continue to reinforce these skills.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-07	Event Sequencing - In this Module, you will learn how to design and interpret PLC programs that control the sequence of operations of entire machines. This is an important topic because most PLC programs perform a sequence of some kind.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-08	Application Development - In the previous Module, you learned the basics of designing and interpreting PLC programs that control machine sequencing. Event sequencing programs, you may have noticed, can seem very complicated. In this Module, you will learn a step-by-step technique that makes reading and designing event sequencing programs much easier.	\$10.00	20.00%	\$8.00	PLCs

W-B490-BC-09	PLC Timer Instructions - In this Module, you are going to learn about PLC timer instructions and their applications. PLC programs often use timers. An example is to sequence the events in a chemical mixing process.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-10	PLC Counter Instructions - In this Module, you are going to learn how to use counter instructions and how to interface BCD thumbwheels and LED displays to the PLC. Counter instructions are important because they allow a PLC to keep track of production and other data as well as control functions that are based on counting. The BCD thumbwheel switch and LED display are commonly used with PLCs to input and display timer/counter preset and accumulated values. To use them, you will learn two more instructions: FRD and TOD.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-11	Program Control Instructions - In previous Modules you've learned how basic PLC instructions work. In this Module, you will learn about some new instructions called program control instructions and the effect of these instructions on the PLC processor and I/O scan. Program control instructions are important because they are used in almost all industrial PLC programs to organize and simplify PLC programs.	\$10.00	20.00%	\$8.00	PLCs
W-B490-BC-12	Math and Data Move Instructions - One of the capabilities of a powerful PLC such as the SLC-500 is its ability to manipulate and perform operations on data which is associated with the process. This capability is what makes the PLC more like a computer and less like a replacement for relay control. In this Module, you will begin your study of these capabilities by learning how to use the four basic math instructions: addition, subtraction, multiplication, and division. These instructions can be used to calculate production times, production rates, and other types of production data. In the last segment of the Module, you will learn how to transfer data between data words using the Data Move instruction. Specifically, you will use it to output data to an LED display and a programmable message display. It is important to include logic in your program to output information to a display which can be used by operators to monitor machine status.	\$10.00	20.00%	\$8.00	PLCs
W-B502-XC-01	Introduction to Mechanical Drive Systems - Companies all over the world are increasingly automating their processes in order to become more competitive. Automation not only requires more sophisticated controls, usually in the form of a computer, but it also requires more sophisticated mechanical systems as well. Mechanical systems must be more reliable and precise. This means that the people who design, install, and maintain mechanical systems must increase their knowledge and skills. In this learning system, Mechanical Systems 1, and other learning systems which follow, you are going to learn how to select, install, adjust, troubleshoot, and repair a range of mechanical systems which are commonly found in both automated and manual machines used in every industry around the world. These industries include manufacturing, construction, military, communications, and transportation. In this first Module you will learn about general safety practices for mechanical systems and how to mount and level an electric motor. These skills will be applied to all Modules that follow. The electric motor is by far the most common device used to drive mechanical systems.	\$10.00	20.00%	\$8.00	Mechanical
W-B502-XC-02	Key Fasteners - In the previous Module you learned how to mount and operate the motor, but you didn't connect it to anything. In this Module you will learn how a key fastener connects the motor shaft to other devices. On the job, you will encounter key fasteners in almost every rotating machine application. In this Module you will use a key fastener to connect the motor to a prony brake. The prony brake is a device that is used to place a load on a motor. It was chosen for two reasons: it is a simple device to connect to the motor because it does not require much alignment and it allows you to learn about motor torque and power. In later Modules the prony brake will also be used to load the mechanical transmission system to demonstrate the effects of real world loads on the system.	\$10.00	20.00%	\$8.00	Mechanical
W-B502-XC-03	Power Transmission Systems - In the previous Modules you learned how to attach the motor shaft to a hub using a key fastener. In this Module you will build on this skill by coupling the motor shaft to an independently mounted driven shaft which requires precise alignment with the motor shaft. Alignment is one of the factors that most affects the life of rotating machinery. If it is not done correctly, the components can wear out quickly. Also, as part of this Module you will learn about two important power transmission components: bearings and couplings. Every transmission machine you will work with has bearings and couplings of some kind. This Module will serve as an introduction to both. In later Modules you will learn more about each of them.	\$10.00	20.00%	\$8.00	Mechanical
W-B502-XC-04	Introduction to V-Belt Drives - In the previous Module, you learned how to couple two shafts which are in line with each other. Another method of shaft-to-shaft power transfer is to couple two shafts which are parallel with each other. There are three common methods of doing this: chain drive, gear drive, and belt drive. In this Module you will begin your study of one of these methods: The Belt Drive, specifically the v-belt drive. The belt drive is the most common of the three methods, and the v-belt drive is the most common type of belt drive. The v-belt is popular because it is inexpensive, requires no lubrication, accepts greater misalignment than chains or gears, and absorbs shock loads.	\$10.00	20.00%	\$8.00	Mechanical
W-B502-XC-05	Introduction to Chain Drives - This Module will begin your study of another method of adjacent shaft-to-shaft power transfer, the chain drive. Along with the belt drive, the chain drive is also common in industry because it is more efficient than the v-belt. A chain drive can handle higher power loads than a v-belt, and it does not slip. While there are many types of chain drives, the most widely used type is the roller chain drive. This is the type you will learn about in this Module.	\$10.00	20.00%	\$8.00	Mechanical

W-B502-XC-06	<p>Spur Gear Drives - In this Module, you will begin your study of the third type of adjacent shaft-to-shaft power transfer drive, the gear drive. The gear drive was the first type of drive invented. It has been in use for thousands of years and is today used in a wide variety of applications from machine tool drives to computer printers. Gear drives are preferred over belts and chains for applications that require either very high speeds, very high loads, very high gear ratios, or compact gear reduction. Gears also allow the direction of rotation to be reversed and shafts to be turned at right angles. A final advantage of gears is that they do not slip, making them ideal for synchronizing applications. Although there are many types of gear drives, the spur gear is the most common because it is low in cost and easy to maintain. It is also the fundamental gear design from which all other gears are designed. This makes it a good type to use to teach the general concepts of the operation of all types of gears, and, therefore, this Module will focus on spur gears.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B502-XC-07	<p>Multiple Shaft Drives - In the last Module, you learned about gear drives which only have two gears. In this Module, you will continue your study of gear drives by exploring the operation and applications of gear drives which have more than two gears. Multiple pairs of gears can be used to drive multiple output shafts, create higher gear ratios, and reverse the direction of rotation of output shafts which are on the same axis as the input shaft. These setups are quite common in gear reducers and other machinery. Also, this Module will continue your study of couplings by learning about solid couplings. Solid couplings are used both for very small and very large motors. They are also used to extend the length of a shaft by connecting it to another shaft. The major disadvantage of solid couplings is that they can tolerate no misalignment.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-01	<p>Heavy Duty V-Belt Drives - In this first Module of Mechanical Systems Course Level 2, Model 95-ME2, you will continue the study of v-belt drives you began in Level 1 by learning about the operation and installation of conventional belts and wedge belts, both in single and multiple configurations. These types of belts are more often used in industry than FHP belts because of their ability to handle higher operating speeds and loads. You will also learn how to install drives which use bushings. Bushings are commonly used in industrial drives in place of the finished bore mounting method. There are three types of bushings commonly used. In this Module, you will learn to install each of them.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-02	<p>V-Belt Selection and Maintenance - In this last Module in the v-belt series, you will learn how to identify, specify, and select sizes of v-belts and their drive components. This is an important skill for either replacing components on older drives or selecting components while designing new ones. Also, you will learn how to maintain and troubleshoot v-belt drives. If v-belts are properly maintained, they will give long, trouble-free service.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-03	<p>Synchronous Belt Drives - In this Module, you will learn about a new type of belt drive system. Synchronous Belt Drives, also known as Positive Drives, are really a hybrid between V-belt, gear, and chain drives. That is Synchronous Belt drives combine many of the best features of each. You will learn the operation and applications of two types of synchronous belts: the Timing belt and the High Torque Drive (HTD) belt. You will also learn how to install and align these types of belt drives. You will also learn how to select a type and size of synchronous belt drive for a given application and how to maintain, inspect, and troubleshoot it.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-04	<p>Lubrication Concepts - Nearly every industry in the world uses a machine of some sort. In order for these machines to function properly and last as long as they were designed to, component wear and tear must be kept to a minimum. This is accomplished through proper lubrication. In this Module you will learn about the various types of lubricants and how they are applied. The use of this information is vital in preventing the premature failure of any type of machine.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-05	<p>Precision Shaft Alignment - In Mechanical Systems 950-ME1, you learned one method of shaft alignment, the straight and edge feeler gauge method. This method is the least accurate method, but it works well for elastomeric couplings which do not need precise alignment. Many other types of couplings, typically those used in higher speed or high torque applications, need more precise alignment. In this Module, you will learn how to perform two precision alignment methods which can be used for these applications, the face and rim method and the reverse indicator method. These two methods both use dial indicators to perform precision shaft alignment. In this Module, you will also learn how to install and align two new types of couplings, the elastomer-in-shear type and the flange coupling. The elastomer-in-shear coupling belongs to the same family of couplings to which the flexible jaw coupling belongs. The flange coupling is a solid coupling, belonging to the same family as the sleeve coupling.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-06	<p>Couplings - In this Module, you will continue to apply the shaft alignment skills you learned in the previous Module to three new types of couplings which comprise a group called flexible metal couplings. These couplings are the types which are used to couple shafts for heavy duty applications which can include high power, high speed, high shock loads, or corrosive environments. In the final segments of this Module you will learn how to select, maintain, and troubleshoot all couplings covered in this Module and earlier ones.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B503-XC-07	<p>Heavy-Duty Chain Drives - In the Mechanical Systems 1 course, you were introduced to chain drives and their basic operation, particularly roller chain drives. In this Module, you will learn about two more types of chain drives commonly used in industry: silent chain drives and multiple strand chain drives. You will also learn how a particular chain drive is selected based on the application and how to lubricate and maintain a chain drive system.</p>	\$10.00	20.00%	\$8.00	Mechanical
W-B701-XA-01	<p>Band Saw Operation - This Module is going to teach you how to safely operate the power band saw. The band saw is used to cut off raw material into shorter lengths that can be used in the manufacturing process. It is found in every manufacturing plant and is the first machine you would be assigned to operate if you were hired at a machine shop. The power band saw is a basic machine, but it does require that you learn to use correct procedures. In this Module, you will start with learning the parts and controls of the band saw, basic operation and safety procedures. Then you will operate the band saw to create a part.</p>	\$10.00	20.00%	\$8.00	Machine Tools

W-B701-XA-02	Introduction to the Drill Press - This Module is going to teach you how to safely operate a very versatile manufacturing tool machine, the drill press. The drill press is used to create holes. This machine is found in every manufacturing plant and tool shop. It is a relatively easy machine to learn to operate. Yet, it can be used to perform complex tasks that require a great deal of skill. You will be given step-by-step instructions that will teach you some of the skills desired by employers for entry level positions.	\$10.00	20.00%	\$8.00	Machine Tools
W-B701-XA-03	Drill Press Operations - In this Module, you will continue using the drill press to create various types of holes used in the manufacturing environment. These include the countersink, counterbore, reamed, and tapped holes. These operations will be performed on the drill specimen you worked with in the previous Module.	\$10.00	20.00%	\$8.00	Machine Tools
W-B702-XX-01	Introduction to Manufacturing Hand Tools - In this Module, you will learn how to use two important hand tools: the hacksaw and the file. These tools will help get you started on a project with which you will work over the next few Modules: a paper clip holder. In addition, you will learn a technique for applying layout marks to round stock.	\$10.00	20.00%	\$8.00	Machine Tools
W-B702-XX-02	Intoduction to the Manual Milling Machine - This Module will teach you how to operate the milling machine. The milling machine is a very flexible machine tool that is used extensively in the machine shop. In this Module you will learn how a milling machine works, milling machine safety, and basic milling operations. Also in the Module, you will learn how to perform a facing operation to achieve high dimensional accuracy on the parts you create.	\$10.00	20.00%	\$8.00	Machine Tools
W-B702-XX-03	Milling Processes - This Module covers additional procedures used in the operation of the milling machine. The skills you acquire in this Module will enable you to better understand the versatility of the milling machine. As you learn these skills, you will continue working with the paper clip holder project you started in the previous Module.	\$10.00	20.00%	\$8.00	Machine Tools
W-B703-XB-01	Control Logic - In this Module and the ones that follow, you are going to begin your learning about the electrical controls that are used with automated machines. Specifically, you will learn about a type of control called electrical relay control. This type of control uses electrical components that are wired together to form the logic that determines the sequence of the machine's operations. Relay controls do not use a computer, but the principles they use are also used in a type of industrial computer called a programmable controller. Therefore, your study of relay control will help you learn about the machines that use this type of control and you will be a step ahead in learning about programmable controllers. To learn about relay control, you will be building basic logic circuits with the Amatrol trainer which will control outputs such as a lamp or pneumatic solenoid valve. These principles will then be used in the Modules that follow to construct fully automated machine control circuits.	\$10.00	20.00%	\$8.00	Electrical Control
W-B703-XB-02	Sequencing Control - In this Module, you will learn how to use the control relay and a type of automatically-operated switch called a limit switch. With control relays and limit switches, designers can develop electrical circuits that will automatically perform a sequence of operations to control many types of machines.	\$10.00	20.00%	\$8.00	Electrical Control
W-B703-XB-03	Timers and Advanced Systems - In this Module you will first learn about the function and operation of time-delay relays and their applications. The idea of using time as a control device is not new. You use time-controlled devices everyday at home, at school, and at work. In the morning, an alarm clock wakes you up at a predetermined time. At work, a time clock sounds a buzzer at lunch time. Time control is the most common method of sequencing the events in our lives. Next you will learn about control circuits that can control multiple cylinders and can provide both automatic and manual modes of machine operation.	\$10.00	20.00%	\$8.00	Electrical Control
W-B705B-BA-01	Introduction to CNC Mill Programming - In this Module, you are going to learn how to operate a CNC milling machine and to develop a basic program that will run the machine.	\$10.00	20.00%	\$8.00	CNC Machining
W-B705B-BA-02	Basic CNC Mill Programming - When working in a CNC machining environment, programming is only part of the process. Tooling must be correctly selected and installed. Parts made on CNC machines will often have tight tolerances which can not be met using manual operations. CNC machines can be accurate to within 0.01 mm(0.005"), but without a proper setup, the finished part dimensions will still be wrong. This Module will teach you the basic fundamentals of CNC mill programming, which include: linear interpolation, startup and shutdown blocks, tooling selection, and accurate PRZ location.	\$10.00	20.00%	\$8.00	CNC Machining
W-B705B-BA-03	Circular Interpolation - Programming straight lines is only the beginning of a good CNC program. Almost every part made on a CNC machine will have some form of arc or circle on it, and these are programmed differently than linear interpolations. In this Module, you will be introduced to circular interpolation commands, which are used to make arcs and circles, as well as other CNC commands that will help to expand your CNC knowledge. Although you will learn the programming syntax specifically for the Denford CNC Mill, with only minor changes, the same commands and codes are applicable on most other brands of CNC Mill.	\$10.00	20.00%	\$8.00	CNC Machining
W-B706D-DA-01	Speeds and Feeds -	\$10.00	20.00%	\$8.00	CNC Machining
W-B706D-DA-02	CNC Mill Canned Cycles -	\$10.00	20.00%	\$8.00	CNC Machining
W-B706D-DA-03	CNC Mill Cutter Compensation -	\$10.00	20.00%	\$8.00	CNC Machining

W-B707-AC-01	Basic Electrical Circuits - Electricity is used to perform tasks related to almost everything we do. In this unit, you are going to learn the fundamental concepts of electricity used in many applications, especially control systems. The specific skills you learn will enable you to perform basic electrical projects at home and on the job. These skills will also be applied in many other units including programmable controllers, electrical motor control, and electrofluidpower. In this Module, you will learn how a basic electrical circuit works by setting up a number of circuits using the various components in the Amatrol T7017 AC/DC Electrical Learning System. This will also help you get more familiar with the operation of the trainer you will be using.	\$10.00	20.00%	\$8.00	Electricity
W-B707-AC-02	Electrical Measurement - In this Module, you are going to learn how to perform basic measurements of voltage, resistance and current in series and parallel circuits. The skills you learn here will be used every time you troubleshoot or test an electrical circuit.	\$10.00	20.00%	\$8.00	Electricity
W-B707-AC-03	Circuit Analysis - In the previous Module, you learned how current, resistance and voltage are affected by circuits with series and parallel loads. You did not, however, attempt to analyze the precise relationship between these three characteristics. In this Module, you will do just that through Ohm's Law and Kirchhoff's voltage and current laws. These laws are fundamental concepts used by every electrician, electronics technician, and electrical engineer. One application of these laws is to determine how much power is needed for a circuit. You will learn to do this calculation in this Module.	\$10.00	20.00%	\$8.00	Electricity
W-B728-XB-01	Introduction to Levers - This Module will cover three types of basic levers and their application. It will also cover how to measure the forces applied to these levers. Additionally, the Module will teach some of the terms used to describe other simple mechanical devices and how these terms can be used to describe how these devices work. Most importantly, safety measures that need to be followed when working with or around mechanical systems will be presented.	\$10.00	20.00%	\$8.00	Mechanical Drives
W-B728-XB-02	Linkages, Cams, and Turnbuckles - This Module will explain friction, and the effects it has on moving objects. The Module will discuss benefits and disadvantages of friction, and how they relate to mechanisms, and mechanical systems. The Module will then define linkages, cams and turnbuckles and how to measure forces applied to them.	\$10.00	20.00%	\$8.00	Mechanical Drives
W-B728-XB-03	Pulley Systems and Gear Drives - This Module will cover how a pulley works and the advantages of pulleys and pulley systems. It will also cover the types and applications of the simple gear train and the components used to transmit forces in a power transmission system. Both of these simple mechanical systems provide a mechanical advantage. You will calculate and measure the mechanical advantage of both of these systems.	\$10.00	20.00%	\$8.00	Mechanical Drives
W-B763-AA-01	Introduction to Programmable Controllers - The Programmable Logic Controller (PLC) is a microprocessor-based controller designed to provide easily programmed control of almost any type of process. Its development is very important because the PLC has done for the shop floor what the personal computer has done for the office. This course will teach you how to design, program and operate the PLC to control a number of process applications used by industries all over the world. The skills you will learn are in high demand everywhere today. In this first Module you will learn about the basic operation of the PLC and how its programming language works. In the Module that follows, you will learn how to enter programs.	\$10.00	20.00%	\$8.00	PLCs
W-B763-AA-02	Basic PLC Programming - In this Module, you will learn how to enter, edit, and store PLC programs using PLC software. You will also learn about the PLC's memory, how it is organized, and what types of numbering systems are commonly used with the PLC. All of these skills are important to be able to fully understand and operate the MicroLogix 1000.	\$10.00	20.00%	\$8.00	PLCs
W-B763-AA-03	PLC Motor Control - In the first three segments of this Module, you will learn how the PLC is programmed to control electric motor applications. To do this, you will learn about the sixth logic element, which is memory. The programs and instructions you will learn in this Module are not limited to motor control but are fundamental to all PLC programs. In the last segment, you will learn how to add comments to your PLC programs and how to copy and paste sections of your program.	\$10.00	20.00%	\$8.00	PLCs
W-B763-AA-04	Event Sequencing - In this Module you will learn how to design and interpret PLC programs that control the sequence of operations of entire machines. This is an important topic because most PLC programs perform a sequence of some kind.	\$10.00	20.00%	\$8.00	PLCs
W-B764-AA-01	Application Development - In the Computer Control 1 Unit, you learned the basics of designing and interpreting PLC programs that control machine sequencing. Event sequencing programs, you may have noticed, can seem very complicated. In this Module, you will learn a step-by-step technique that makes reading and designing event sequencing programs much easier.	\$10.00	20.00%	\$8.00	PLCs
W-B764-AA-02	PLC Timer Instructions - In this Module, you are going to learn about PLC timer instructions and their applications. PLC programs often use timers. An example is to sequence the events in a chemical mixing process.	\$10.00	20.00%	\$8.00	PLCs
W-B764-AA-03	PLC Counter Instructions - In this Module, you are going to learn how to use counter instructions and special functions that are used in PLC applications. Counters are important because they allow a PLC to keep track of production and other data as well as control functions that are based on counting. The special functions you will learn about in this Module are commonly used to do tasks in addition to making the machine perform its basic sequence.	\$10.00	20.00%	\$8.00	PLCs

W-B830-XB-01	Introduction to Electronic Sensors - This is the first of a two Module series covering the operation and applications of electronic sensors. Electronic sensors provide reliable low-cost input and monitoring for electrical control systems, and are used in almost every industry. Anyone working (or expecting to work) in the industrial maintenance or engineering fields should have a thorough understanding of electronic sensors. In this Module, you will read about the basic construction and operation of electronic sensors in general, and inductive and capacitive proximity sensors in particular. You will also perform hands-on skills using the 85-SN Electronic Sensors Learning System. These skills are intended to teach the user the wiring and operational characteristics of inductive and capacitive proximity sensors.	\$10.00	20.00%	\$8.00	Sensors
W-B830-XB-02	Electronic Sensor Applications - This is the second Module of a two Module series covering the operation and applications of electronic sensors. Electronic sensors provide reliable low-cost input and monitoring for electrical control systems, and are used in almost every industry. Anyone working (or expecting to work) in the industrial maintenance or engineering fields should have a thorough understanding of electronic sensors. The first Module covered the basic construction and operation of inductive and capacitive proximity sensors. In this Module, you will read about the basic construction and operation of magnetic reed switches, Hall-Effect sensors, and photoelectric sensors. You will also perform hands-on skills using the 85-SN Electronic Sensors Learning System. These skills are intended to teach the user the wiring and operational characteristics of magnetic reed switches, Hall-Effect sensors, and photoelectric sensors. Also included is a segment of optional design skills that can be performed if your school has the optional equipment listed below.	\$10.00	20.00%	\$8.00	Sensors
W-B831-XA-01	Linear Motion Hydraulic Systems - Hydraulic power technology is used to power machines in almost every manufacturing plant in the world. It has many unique features that have caused its use to continue to grow rapidly. This module is going to teach you the basic skills in hydraulics. You will learn to connect and operate basic components and systems, read circuit diagrams, monitor system operation, and design circuits. To learn these skills you will be working with the Amatrol 850 series hydraulic trainer. This trainer is designed with real world industrial components that will allow you to set up actual circuits and test their operation. In this first hydraulic Module, you will learn how to start up and operate a hydraulic power supply and then connect a basic circuit.	\$10.00	20.00%	\$8.00	Hydraulics
W-B831-XA-02	Rotary Motion Hydraulic Systems - In this Module, you are going to learn about two new components: motors and needle valves. Both are often used in hydraulic circuits. Before you do this, however, you will learn more about hydraulic pumps in segment 1. In the last segment, you will strengthen your ability to interpret and create hydraulic schematics. These are important skills you will need if you work with fluid power.	\$10.00	20.00%	\$8.00	Hydraulics
W-B831-XA-03	Principles of Hydraulic Pressure and Flow - In previous Modules, you learned about the construction and operation of basic hydraulic circuits and how they are represented using standard schematic symbols. Before you go further, it is important to understand the principles that allow power to be transmitted by a pressurized liquid. With a good understanding, you can then develop skills that are used in analyzing, specifying and troubleshooting hydraulic components. This Module will provide you with the foundation for understanding the theory of fluid power with the principles of pressure and flow. You will learn about Pascal's Law and how it is used to multiply and transmit forces, how to determine cylinder forces and how fluid flows.	\$10.00	20.00%	\$8.00	Hydraulics
W-B831-XA-04	Hydraulic Speed Control - In Module 2 you learned to control the speed of actuators using a needle valve or by feathering the DCV. You didn't explore many details about how these techniques work, you just used them. In this Module, you will learn the details of why a needle valve or feathering a DCV causes the flow rate to be reduced. Also, in this Module you will learn about two new valves: the flow control valve and the check valve. You will then use these valves to design a number of circuits that control actuator speed.	\$10.00	20.00%	\$8.00	Hydraulics
W-B831-XA-05	Hydraulic Pressure Control - The relief valve you studied in an earlier Module is part of a family of hydraulic valves called pressure control valves. This Module will introduce you to two more in this family: sequence valves and pressure reducing valves. Both of these valves are commonly used.	\$10.00	20.00%	\$8.00	Hydraulics
W-B832-XA-01	Hydraulic DCV Applications - The hydraulic directional control valve you used in Basic Hydraulics is a lever-operated, 3-position type that blocks all ports in the center position. To serve the needs of all applications there are many types of DCVs. In this Module, you will learn about these other types of DCVs and how they are applied.	\$10.00	20.00%	\$8.00	Hydraulics
W-B832-XA-02	Hydraulic Cylinder Applications - Hydraulic cylinders are used in many applications. To meet the needs of these applications, special cylinder types, options and circuits are often needed. In this Module, you will learn about some of the circuits which are used to increase the speed of a cylinder and maintain its speed even when load changes.	\$10.00	20.00%	\$8.00	Hydraulics
W-B832-XA-03	Hydraulic Relief Valve Operation - Relief valves are used in almost every hydraulic circuit. In B831, Basic Hydraulics, Module 4, you learned that there are two relief valve designs commonly used in hydraulic applications, direct-operated and pilot-operated, and how they limit pressure in the circuit. Besides limiting the pressure, there are other ways in which these valves are used. In this Module, you will learn more about the operation of the relief valve and its other applications.	\$10.00	20.00%	\$8.00	Hydraulics
W-B832-XA-04	Hydraulic Check Valve Applications - The check valve is one of the few commonly used hydraulic valves that virtually does not leak. In this Module, you will learn how to apply the simple check valve to prevent cylinder relaxation during momentary drops in pressure. You will also learn how to apply a special kind of check valve, called the pilot-operated check valve, to hold loads in place over long periods of time, even when hydraulic power is shut off.	\$10.00	20.00%	\$8.00	Hydraulics

W-B832-XA-05	Accumulator Applications - The accumulator is used to store hydraulic energy that is not consumed by the actuators. This device is very useful in applications where there is a need for hydraulic power in the event of an electrical power failure or periods of high and low flow demands. The accumulator is to a hydraulic system what a capacitor is to an electrical system. In this Module, you are going to learn about accumulator operation, safety, application circuits and sizing.	\$10.00	20.00%	\$8.00	Hydraulics
W-B834-BA-01	Pneumatic Power Systems - Pneumatic power technology is used to power machines in almost every manufacturing plant in the world. They have many unique features that have caused their use to continue to grow rapidly. This learning system is going to teach you basic skills in pneumatic power: You will learn to connect and operate basic components and systems, read circuit diagrams, monitor system operation, and design circuits. To learn these skills you will be working with the Amatrol 850 series pneumatic system. This is designed with real world industrial components that will allow you to set up actual circuits and test their operation. In this first pneumatic Module, you will be introduced to pneumatic power by learning how to use the pneumatic system to connect and operate pneumatic circuits safely. Additionally, you will begin to learn how pneumatic circuits are drawn using symbols, a necessity for anyone working with pneumatic equipment.	\$10.00	20.00%	\$8.00	Pneumatics
W-B834-BA-02	Basic Pneumatic Circuits - In this Module, you are going to learn about two new types of actuators: single-acting cylinders and motors. Both of these actuators are often used in pneumatic circuits. In the segment of this Module you will strengthen your ability to interpret and create pneumatic schematics. These are important skills you will need if you work with fluid power.	\$10.00	20.00%	\$8.00	Pneumatics
W-B834-BA-03	Principles of Pneumatic Pressure and Flow - In previous Modules, you learned about the construction and operation of basic pneumatic circuits and how they are shown using standard symbols. Before going further, it is important to understand the principles that allow power to be transmitted by a pressurized gas. With a good understanding, you can then develop skills that are used in analyzing, specifying and troubleshooting pneumatic components. This Module and the next one will provide you with the basic foundation principles of pneumatics.	\$10.00	20.00%	\$8.00	Pneumatics
W-B834-BA-04	Pneumatic Speed Control Circuits - As you know, pneumatic actuator speed is controlled by the air flow rate at the actuator. Flow rate can be changed either by changing the regulated supply pressure or by restricting flow with a needle valve. In this Module, you will first learn about the check valve and how it is combined with the needle valve to form the flow control valve, the valve most commonly used to control actuator speed. Then you are going to learn how to connect the flow control valve into different types of applications. These methods are called flow control or speed control circuits. Selecting the correct speed control circuit for each application is a common design task for an engineer or designer. For the technician, this is also important because it helps you understand how to adjust these systems.	\$10.00	20.00%	\$8.00	Pneumatics
W-B835-BA-01	Pneumatic DCV Applications - In this Module, you will learn about two additional methods of shifting pneumatic directional control valves and how these valves are applied in everyday pneumatic circuits.	\$10.00	20.00%	\$8.00	Pneumatics
W-B835-BA-02	Air Logic - Pneumatic power circuits can be controlled by pneumatic controls as well as electrical controls. In this Module, you will learn how basic pneumatic control circuits work and where they are used.	\$10.00	20.00%	\$8.00	Pneumatics
W-B835-BA-03	Pneumatic Maintenance - Good pneumatic maintenance techniques can help minimize cost and improve plant reliability. In this Module, you will learn the basic functions of pneumatic maintenance including how to maintain, select and operate filters, lubricators, dryers, and traps. You will also learn some basic component servicing skills.	\$10.00	20.00%	\$8.00	Pneumatics
W-B837-XB-01	Introduction to Electronic Sensors - This is the first of two Modules covering the operation of electronic sensors and their applications. Electronic sensors are used in almost every industry because they are reliable, long lasting and are relatively low in cost! The information you learn in these Modules will benefit you in all industrial disciplines that use any type of electrical control system.	\$10.00	20.00%	\$8.00	Sensors
W-B837-XB-02	Electronic Sensor Applications - This Module continues your study of electronic sensors. The types of electronic sensors you will study in this Module are types that use the presence of a magnetic field to sense the target. Magnetic sensors are often used in computer keyboards and fluidpower applications.	\$10.00	20.00%	\$8.00	Sensors
W-B838-XA-01	Moving Loads Pneumatically - In this Module, you will learn how pneumatic actuators react to various types of loads and how to design circuits that enable the actuator to perform its task effectively. As you will soon see, pneumatic actuators are affected greatly by the types of loads they encounter.	\$10.00	20.00%	\$8.00	Pneumatics
W-B838-XA-02	Vacuum Systems - All previous pneumatic Modules have dealt with using compressed air for power transmission. Another area of pneumatics commonly used in industry is vacuum systems. Your knowledge of pneumatics would not be complete without a basic knowledge of these systems. This Module will introduce you to vacuum systems by teaching you how vacuums are generally specified, measured, created and used in industry. These are the basic skills that any technician or engineer needs when working with vacuum systems.	\$10.00	20.00%	\$8.00	Pneumatics
W-B838-XA-03	Air Compressors - The air compressor is the heart of a pneumatic system, so it is important that it operate reliably. In this Module, you will learn how various types of air compressors work. You will also learn how to operate a reciprocating type air compressor, which is the most common type found in industry, and how to judge the performance of an air compressor both before and after it is purchased.	\$10.00	20.00%	\$8.00	Pneumatics

W-B839-XA-01	Hydraulic Motor Applications - Hydraulic motors are used in a wide range of applications. There are many types of standard hydraulic motors available to meet the requirements of each application. In this Module, you will expand your knowledge of hydraulic motors by learning about the basic operation of several types of hydraulic motors and how to choose the correct motor for a given application. One important aspect of hydraulic motor circuits is stopping the motor, or braking. In this Module, you will learn about the special valves and circuits that are used to stop hydraulic motors.	\$10.00	20.00%	\$8.00	Hydraulics
W-B839-XA-02	Hydraulic Pump and Motor Performance - In this Module, you will learn about the basic performance characteristics of pumps and motors. Their performance are covered in this Module because they use similar designs. These characteristics are important to both designers and troubleshooters. Troubleshooters need this knowledge because it will allow them to determine whether the pump or motor is working correctly or if it needs servicing. Designers need this knowledge because it will help them design systems that work correctly the first time.	\$10.00	20.00%	\$8.00	Hydraulics
W-B839-XA-03	Fluids and Conditioning - In this Module, you will learn about the fluid conductors and fluids commonly used in hydraulics. You will also learn about the components used to store, clean, and cool the fluids in order to maintain top performance and long life from the hydraulic machine. Contaminants in hydraulic fluid reduce machine life and dependability. A broken hydraulic machine can cause a production shutdown costing thousands of dollars.	\$10.00	20.00%	\$8.00	Hydraulics
W-B861-XA-01	Introduction to Electrical Control Systems - A large number of automated machines operating today use either hydraulic or pneumatic systems to provide the muscle to perform their tasks. Most of these fluid power systems are electrically controlled. This course will teach you how relay-type electrical control systems work and how they are applied to control hydraulic and pneumatics systems. Relay control is one of the oldest types of electrical control systems but it is important because the concepts are still commonly used by many other types of control systems such as programmable controllers. This first Lap covers the basic concepts of electrical circuits and control logic.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-02	Basic Control Devices - The ladder diagram is the standard method used to represent electrical relay control circuits. In this Module, you are going to learn the basic rules for creating ladder diagrams and the main basic input/output devices found in almost all circuits: manual switches and indicator lights.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-03	Power Devices - Electrically-controlled valves provide the interface between the control circuit outputs and the fluid power system it controls. In this Module, you will learn how these valves work and how they are represented in control schematics. In the final segment of this Module, you will learn about transformers and circuit protection. These devices must be sized to provide the power used by the control circuit, most of which is used by the output devices such as electro-fluid power valves.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-04	Control Relays - In this Module, you will learn how control relays can be used to control fluid power systems. As part of this, you will learn how the sixth element of logic, memory, works. The memory logic function is an important concept because it is the building block for creating multiple-step sequence control circuits.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-05	Sequencing Control - In this Module, you will learn how to use the control relay and the limit switch in a control circuit. With control relays and limit switches, designers can develop electrical circuits that will automatically perform a sequence of operations to control many types of machines.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-06	Timer Control - In this Module you will first learn about the function and operation of time-delay relays and their applications. The time-delay relay is a type of control relay that switches its contacts to a new state after a predetermined time has elapsed. It is popularly used in fluid power applications to cause a dwell between steps as with a plywood press or a plastic injection molding machine. You will also learn about the operation of photo-electric sensors. Photo-electronic sensing is useful in applications to sense the presence of objects without making physical contact.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-07	Pressure Control Applications - There are many applications in industry where it is important for a machine to change pressures during a machine's cycle. In this Module, you will learn how to electrically control the hydraulic system pressure using a solenoid-operated relief valve. You will also learn about how pressure switches can be used to change the speed of traverse of a cylinder.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B861-XA-08	Circuit Applications - Control circuit applications should include features that will shut down the system should any unsafe condition present itself. Some situations require that the system is shut down immediately, and sometimes it may be preferable to shut down after a cycle has completed to save on unnecessary damage of materials. In this Module you will learn how these features and other special functions are designed into relay control circuits.	\$10.00	20.00%	\$8.00	Electro-Fluid Power
W-B862-XA-01	DC Series Motors - The electric motor is the primary device for generating mechanical power in industrial, commercial, and residential applications. Motors provide power to move our automobiles, drive machinery, and to turn the blades on a fan, just to name a few applications. There are many types of electric motors available, each with their own special operating characteristics. As you progress through this module, you will learn about some of these motors and how they are applied. In this Module, you will learn the about the basic operation of an electric motor and electric motor safety procedures. You will also learn about the most basic type of DC motor, the DC series motor.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-02	DC Shunt and Compound Motors - This is the second Module focusing on DC motors. In this Module, you will learn about the shunt and compound DC motor configurations. You will learn how they are connected, their operational characteristics and their applications.	\$10.00	20.00%	\$8.00	Electric Motors

W-B862-XA-03	Motor Speed and Torque - In this Module, you will learn about two important motor characteristics: speed and torque. This will include learning how to measure them and why you would need to do so.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-04	Motor Performance - In this Module, you will learn how to calculate, measure, and analyze the performance characteristics of electric motors, both AC and DC. These characteristics will include: Power Output, Efficiency, and Speed/Torque relationships. As a case study, you will apply these skills to the three DC motor configurations you have studied to verify the advantages and disadvantages of each configuration. Measuring and interpreting the performance characteristics of motors are common skills used by technicians every day to help them troubleshoot motor operation. Engineers also need to be able to interpret motor performance charts in order to select the correct motor for their designs.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-05	Split-Phase AC Motors - In this Module, you will begin your study of AC electric motors. Unlike DC motors, AC motors have many different designs. However, they all use alternating current. So to begin, segment 1 of this Module will introduce some basic characteristics of AC current that apply to AC motor operation. In segments 2 and 3, you will learn about the operation and applications of one type of AC motor, the split-phase AC motor. The split-phase AC motor is a very common motor.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-06	Capacitor-Start AC Motors - In this Module, you will learn how power reacts in AC circuits with inductive loads such as motors. You will learn about power factors in AC circuits, why they are important, and the method used to correct them. In addition, you will learn about another type of single-phase AC motor, the capacitor-start motor.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-07	Permanent-Capacitor and Two-Capacitor Motors - In this Module, you will learn about two more types of single-phase AC capacitor motors: the permanent-capacitor motor and the capacitor-start capacitor-run motor. You will also learn how the configuration of the capacitors in each of these motors affects the operational characteristics of the motors and some applications for each of these motors.	\$10.00	20.00%	\$8.00	Electric Motors
W-B862-XA-08	Three-Phase AC Induction Motors - In this Module, you will learn about one type of three-phase electric motor called the squirrel-cage induction motor. This motor is important because it is used in more applications than any other motor.	\$10.00	20.00%	\$8.00	Electric Motors
W-B863-XA-01	Electrical Wiring Techniques - This Module is part of a two-Module series that will teach you how to install electrical wiring and components. The skills you will learn in this Module will allow you to perform basic wiring tasks that will be needed to complete your project, as well as work on wiring in your house or on the job. In this Module, you will learn how to select a wire size for an application and install a power cord. These are common tasks that an electrician or technician does.	\$10.00	20.00%	\$8.00	Electricity
W-B863-XA-02	Wiring System Installation - In this Module, you will continue to build upon what you learned in the previous Module as you install an electrical system with switches, lights, outlets, and circuit protection. You will be performing many of the procedures that an electrician would perform in order to properly and safely install an electrical system. You will also learn about some of the common components of an electrical system.	\$10.00	20.00%	\$8.00	Electricity
W-B876-XA-09	DC Generators - A generator is a device that creates DC electricity. Generators can be found in portable DC generators, diesel locomotives, as well as aircraft and marine systems. This Module covers the construction, operation, and applications of DC generators.	\$10.00	20.00%	\$8.00	Electric Motors
W-B877-XA-10	Wound-Rotor Motors - A wound-rotor motor is a special type of AC induction motor that provides limited speed control by changing the resistance of its wound rotor. Before the improvements in variable frequency drive (VFD) technology, wound rotor motors were used in many variable speed applications. Today, VFDs and standard induction motors have replaced wound-rotor motors in many applications. However, a few applications such as large cranes and hoists still use wound-rotor motors. This Module covers the construction, operation and performance characteristics of a wound-rotor motor.	\$10.00	20.00%	\$8.00	Electric Motors
W-B878-XA-11	Alternators - The heart of an AC electricity generation system is the alternator. An alternator is the device that actually creates the AC electricity we use every day to do such things as turn on the lights, power up the computer, or watch television. Alternators can be found in any location that generates AC electricity, such as a power plant. This Module covers the construction, operation, and applications of alternators.	\$10.00	20.00%	\$8.00	Electric Motors
W-B878-XA-12	Alternator Synchronization Methods - Alternators are often connected together to provide more power when the demand exceeds the capacity of one alternator. However, the outputs of the alternators must be synchronized before they are connected together. This Module covers three common methods of synchronizing the outputs of alternators.	\$10.00	20.00%	\$8.00	Electric Motors
W-B878-XA-13	Synchronous Motors - Synchronous motors are special AC induction motors that are designed to operate at synchronous speed (no slip) from no load to full load. Synchronous motors are sometimes used in applications that require constant speed over a wide load range. Synchronous motors also are unique because they can operate with a leading power factor. This enables them to correct the power factor in industrial applications where the loads tend to be mostly inductive (i.e. motors, transformers, industrial furnaces, etc) and thereby reduce operating costs. This Module covers the construction, operation, and applications of synchronous motors.	\$10.00	20.00%	\$8.00	Electric Motors
W-B894-XA-01	Pneumatic System Construction - In this Module you will learn how to build pneumatic systems from scratch by installing fittings and pneumatic hose to components. The skills learned will enable you to select the proper fittings required to make component connections and install fittings to hoses and flexible tubing. These are the skills required of any technician or engineer involved in the construction of pneumatic systems.	\$10.00	20.00%	\$8.00	Pneumatics

W-VTB703-XB-01	Control Logic - In this Module and the ones that follow, you are going to begin your learning about the electrical controls that are used with automated machines. Specifically, you will learn about a type of control called electrical relay control. This type of control uses electrical components that are wired together to form the logic that determines the sequence of the machine's operations. Relay controls do not use a computer, but the principles they use are also used in a type of industrial computer called a programmable controller. Therefore, your study of relay control will help you learn about the machines that use this type of control and you will be a step ahead in learning about programmable controllers. To learn about relay control, you will be building basic logic circuits with the Amatrol trainer which will control outputs such as a lamp or pneumatic solenoid valve. These principles will then be used in the Modules that follow to construct fully automated machine control circuits.	\$12.00	16.67%	\$10.00	Electrical Control
W-VTB703-XB-02	Sequencing Control - In this Module, you will learn how to use the control relay and a type of automatically-operated switch called a limit switch. With control relays and limit switches, designers can develop electrical circuits that will automatically perform a sequence of operations to control many types of machines.	\$12.00	16.67%	\$10.00	Electrical Control
W-VTB703-XB-03	Timers and Advanced Systems - In this Module you will first learn about the function and operation of time-delay relays and their applications. The idea of using time as a control device is not new. You use time-controlled devices everyday at home, at school, and at work. In the morning, an alarm clock wakes you up at a predetermined time. At work, a time clock sounds a buzzer at lunch time. Time control is the most common method of sequencing the events in our lives. Next you will learn about control circuits that can control multiple cylinders and can provide both automatic and manual modes of machine operation.	\$12.00	16.67%	\$10.00	Electrical Control
W-VTB707-AC-01	Basic Electrical Circuits - Electricity is used to perform tasks related to almost everything we do. In this unit, you are going to learn the fundamental concepts of electricity used in many applications, especially control systems. The specific skills you learn will enable you to perform basic electrical projects at home and on the job. These skills will also be applied in many other units including programmable controllers, electrical motor control, and electrofluid power. In this Module, you will learn how a basic electrical circuit works by setting up a number of circuits using the various components in the Amatrol T7017 AC/DC Electrical Learning System. This will also help you get more familiar with the operation of the trainer you will be using.	\$12.00	16.67%	\$10.00	Electricity
W-VTB707-AC-02	Electrical Measurement - In this Module, you are going to learn how to perform basic measurements of voltage, resistance and current in series and parallel circuits. The skills you learn here will be used every time you troubleshoot or test an electrical circuit.	\$12.00	16.67%	\$10.00	Electricity
W-VTB707-AC-03	Circuit Analysis - In the previous Module, you learned how current, resistance and voltage are affected by circuits with series and parallel loads. You did not, however, attempt to analyze the precise relationship between these three characteristics. In this Module, you will do just that through Ohm's Law and Kirchhoff's voltage and current laws. These laws are fundamental concepts used by every electrician, electronics technician, and electrical engineer. One application of these laws is to determine how much power is needed for a circuit. You will learn to do this calculation in this Module.	\$12.00	16.67%	\$10.00	Electricity
W-VTB725-AB-01	Basic Measurement - This course, Measurement Tools 1, will teach you the fundamental principles of measurement including: basic measurement, precision measurement, direct gaging, and indirect gaging. The ability to produce a high quality product begins with the ability to determine if, in fact, the product meets specified dimensions. Measurement is the process of determining if products meet these standards. This Module will focus on teaching you how to make dimensional measurements using the U.S. Customary system and the SI Metric system. To do this, you will use several types of rules and a tape measure. Although these measurement tools are basic, it is important that you get a solid foundation because you will use these skills in every Module that follows.	\$12.00	16.67%	\$10.00	Measurement Tools
W-VTB725-AB-02	Precision Measurement Tools - In this Module you are going to learn to measure using a dial caliper and a micrometer. These two instruments are examples of precision measurement tools that are used in every manufacturing plant in the world to determine if parts meet high quality standards. Whether you are a quality control inspector, machinist, or manufacturing engineer, you will need to be able to use these tools.	\$12.00	16.67%	\$10.00	Measurement Tools
W-VTB725-AB-03	Dimensional Gaging - In the previous two Modules of this module, you learned to measure the dimensions of objects using a number of hand-held measuring instruments. As you found, the way you hold these instruments can affect the accuracy of the measurement. In this Module, you are going to learn how to measure objects more accurately using a measurement device, called an indicator, and fixtures used to position and hold the parts. This method avoids the errors of hand-held instruments. The techniques you will learn in this Module will be applied in many different applications. You will use them to align fixtures for machine setup, more accurately measure parts, and measure features of parts that can't be measured with hand-held tools. In addition to learning these new measurement techniques, you will also learn how to communicate data from a measurement device to a computer. This skill will prepare you for the use of computers as a measurement tool.	\$12.00	16.67%	\$10.00	Measurement Tools
W-VTB728-XB-01	Introduction to Levers - This Module will cover three types of basic levers and their application. It will also cover how to measure the forces applied to these levers. Additionally, the Module will teach some of the terms used to describe other simple mechanical devices and how these terms can be used to describe how these devices work. Most importantly, safety measures that need to be followed when working with or around mechanical systems will be presented.	\$12.00	16.67%	\$10.00	Mechanical Drives
W-VTB728-XB-02	Linkages, Cams, and Turnbuckles - This Module will explain friction, and the effects it has on moving objects. The Module will discuss benefits and disadvantages of friction, and how they relate to mechanisms, and mechanical systems. The Module will then define linkages, cams and turnbuckles and how to measure forces applied to them.	\$12.00	16.67%	\$10.00	Mechanical Drives

W-VTB728-XB-03	Pulley Systems and Gear Drives - This Module will cover how a pulley works and the advantages of pulleys and pulley systems. It will also cover the types and applications of the simple gear train and the components used to transmit forces in a power transmission system. Both of these simple mechanical systems provide a mechanical advantage. You will calculate and measure the mechanical advantage of both of these systems.	\$12.00	16.67%	\$10.00	Mechanical Drives
W-VTB780-AA-01	Pneumatic Power Systems - Pneumatic power technology is used to provide power to machines in almost every manufacturing plant in the world. These machines have many unique features that have caused their use to continue to grow rapidly. This module will teach you some basic skills in pneumatic power: You will learn how to connect and operate basic pneumatic components and systems, read circuit diagrams, monitor system operation, and design circuits. To learn these skills you will be working with the Amatrol Pneumatics 1 trainer. This trainer is designed with real world industrial components that will allow you to set up actual circuits and test their operation. In this first pneumatic Module, you will be introduced to pneumatic power by learning how to use the pneumatic trainer to connect and operate pneumatic circuits safely. Additionally, you will begin to learn how pneumatic circuits are drawn using symbols, a necessity for anyone working with pneumatic equipment.	\$12.00	16.67%	\$10.00	Pneumatics
W-VTB780-AA-02	Basic Pneumatic Circuits - In this Module, you are going to learn about two new types of actuators: single-acting cylinders and motors. Both of these actuators are often used in pneumatic circuits. In the last two segments of this Module you will strengthen your ability to interpret and create pneumatic schematics. These are important skills you will need if you work with fluid power.	\$12.00	16.67%	\$10.00	Pneumatics
W-VTB780-AA-03	Principles of Pneumatic Pressure and Flow - In previous Modules, you learned about the construction and operation of basic pneumatic circuits and how they are shown using standard symbols. Before going further, it is important to understand the principles that allow power to be transmitted by a pressurized gas. With a good understanding, you can then develop skills that are used in analyzing, specifying and troubleshooting pneumatic components. This Module will provide you with the basic foundation principles of pneumatics.	\$12.00	16.67%	\$10.00	Pneumatics
W-VTB780-AA-04	Pneumatic Speed Control Circuits - As you know, pneumatic actuator speed is controlled by the air flow rate at the actuator. Flow rate can be changed either by changing the regulated supply pressure or by restricting flow with a needle valve. In this Module, you will first learn about the flow control valve, the valve most commonly used to control actuator speed. Then you are going to learn how to connect the flow control valve into different types of applications. These methods are called flow control or speed control circuits. Selecting the correct speed control circuit for each application is a common design task for an engineer or designer. For the technician, this is also important because it helps you understand how to adjust these systems.	\$12.00	16.67%	\$10.00	Pneumatics
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