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RCAM
Regional Center for Advanced Manufacturing
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INDUSTRIAL MAINTENANCE TRAINING

Workforce Solutions for Your Industry


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RCAM


RCAM
ACADEMY
AT NORTHEAST STATE

Regional Center for Advanced Manufacturing

This catalog will allow you to view a list of maintenance courses offered by Northeast State at the Regional Center for Advanced Manufacturing (RCAM). All courses are instructor led using modern lab equipment common to the industrial environment. Courses are divided into six disciplines which are **Mechanical Instrumentation**, **Electrical, Operations, Automation, and Machining**. Multiple MSSC, NCCER, NC3 and OSHA Certifications are also available.

First, you will see a list of the individual courses offered under each discipline along with the hours required to complete the course.

Next, you may look at detailed objectives for each course topic within the discipline. Objectives will let you know what a learner must be able to do once they have completed the training.

If you have questions or need additional information, please feel free to contact the RCAM at 423-354-5149.

You can also view the RCAM website at http://www.manufacturingfuture.net.

Regional Center for Advanced Manufacturing

RCAM Courses	Hours	Discipline	Page #
Mechanical — ME			
Mechanical Fasteners, Gaskets, Packing, and Flange Assembly	16	ME	9
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Hoses & Tubing	20	ME	11
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Metallic Materials	4	ME	12
Mechanics & Rigging	8	ME	12
Blueprint Reading & Sketching	4	ME	13
Precision Measuring	12	ME	14
Shaft Couplings	4	ME	14
Belts & Pulleys; Chains & Sprockets	12	ME	15
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Thermal Cutting Processes	16	ME	16
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Fundamentals of Problem Solving & Troubleshooting—Mechanical	24	ME	18
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Positive Displacement Pumps	12	ME	20
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Equipment Installation Lab	12	ME	21
Heat Exchangers Lab	8	ME	21
Welding Pipe Lab	20	ME	22
Basic Welding	60	ME	23
Intermediate Welding	90	ME	24
Advanced Welding	120	ME	25

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Instrumentation — I			
Basic Instrumentation Overview	4	I	27
Instrument Fundamentals	20	I	27
Control Valves	16	I	28
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Liquid Level Measurement	8	I	29
Fluid Flow Measurement	8	I	30
Temperature Measurement	8	I	30
Digital Instruments	32	I	31
Electronic Loop Troubleshooting	16	I	31
PLC Fundamentals	16	I	32
Electrical — E			
Industrial Electricity: Basic Principles	16	E	33
Industrial Electricity: Alternating Current	8	E	33
Industrial Electricity: Conductors and Wiring	16	E	34
Electrical Test Equipment	8	E	34
Electrical Drawings	8	E	35
Transformers/Three Phase Electricity Fundamentals	16	E	36
Conduit Installation	16	E	36
Industrial Electricity: Basic AC Motor Controls	32	E	38
AC/DC Motors	24	E	38
DC Fundamentals	24	E	39
AC Fundamentals	32	E	40
Analog Circuits	32	E	41

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Electrical — E Continued			
Digital Circuits	16	E	42
Fundamentals of Problem Solving & Troubleshooting - Electrical	24	E	42
Motor Drives	32	E	43
Managing Electrical Hazards	16	E	43
Introduction to Commercial Electricity	8	E	43
Operations — O			
Chemistry Fundamentals	8	O	44
Distillation	8	O	44
Industrial Skills for New Hires	8	O	45
Operations Multi-Lab	24	O	45
Instrumentation and Control	12	O	46
Introduction to Chemical Manufacturing	16	O	47
Refrigeration	4	O	47
Valves, Piping, and Pumps	8	O	48
Automation — A			
Adjustable Frequency Drive	16	A	49
Introduction to Sensors	24	A	49
Pneumatics System	24	A	50
Robotics Fundamentals I&II	32	A	50
Servo Motors	16	A	51
Vision Sensors System	8	A	51
Machining — MA			
Basic Math	42	MA	52
Safety	45	MA	52
Precision Measuring Instruments: NC3, Snap-On, Starrett Certificate	16	MA	53
Conventional Machine Tool 1:Intro to Machine Tools	86	MA	53

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Machining — MA Continued			
Conventional Machine Tool 2: Intermediate Machining Processes	106	MA	54
Conventional Machine Tool 3: Advanced Machining Processes	64	MA	54
Basic Blueprint Reading	38	MA	54
Applied Mathematics	42	MA	55
Intro to CNC Machine Operations	64	MA	55
Intermediate Blueprint Reading	38	MA	56
Intermediate Applied Math	42	MA	56
Intermediate Blueprint Reading with Basic Essentials for GD&T	38	MA	56
Advanced Measuring Instruments: NC3, Snap-On, Starrett Certificate	70	MA	57
Intro to CNC Programming	102	MA	57
Intro to CAD/CAM	64	MA	58
Metallurgy	38	MA	58
Geometric Dimensioning and Tolerancing	38	MA	59
Advanced Math 1	38	MA	59
Advanced CNC Operations 1:5 Axis and Live Tooling	24	MA	59
Advanced CNC Programming 1:5 Axis Programming	24	MA	60
Advanced CNC Programming 2: Live Tooling	32	MA	60
Welding Basics	8	MA	60
Advanced CNC Operations 2: Jigs and Fixtures	70	MA	61
Advanced CNC Programming 3: Live Tooling and Water Jet Programming	32	MA	61
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Advanced Math 2	38	MA	61
Manufacturing Technology	38	MA	62

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Certifications— C			
Precision Measuring Instruments: NC3, Snap-On, Starrett Certificate	16	MA	53
Advanced Measuring Instruments: NC3, Snap-On, Starrett Certificate	70	MA	57
MSSC Certification(s)			
Certified Production Technician (CPT) 4.0	84	C	63
Certified Logistics Technician (CLT) 4.0	40	C	64
Certified Logistics Associate (CLA) 4.0	40	C	64
NCCER Certificate(s)			
Project Management	116.5	C	65
NC3 Certification(s)			
STEM: DREMEL 3D Printing	24	C	65
Fundamentals of Industry 4.0	8	C	65
Fundamentals of Fluid Power-Pneumatics	24	C	65
Fundamentals of Fluid Power-Hydraulics	24	C	65
Fundamentals of Sensor Technology	24	C	65
Fundamentals of PLC– Siemens	24	C	65
Fundamentals of Robotics	24	C	65
Fundamentals of Electricity	32	C	65
OSHA			
OSHA 10-hour Program Certification	10	C	66
OSHA 30-hour Program Certification	30	C	66

MECHANICAL

Mechanical Fasteners, Gaskets,
Packing and Flange Assembly
NSCC1005520

Lab Objectives

The following is a list of objectives for the Mechanical Fasteners, Gaskets, Packing and Flange Assembly Lab:

- Identify common types of fastening device
- Select the correct type and size of fastening device for a specific task
- Install an internal retainer ring so that it is fully engaged in the groove in a shaft
- Install an external retainer ring so that it is fully engaged in the groove in a shaft
- Layout and drill holes in Bracket Plate DB01 so that all dimensions are +/- 1/8" when measured with a 12" rule
- Correctly tap holes to install bolts
- Drill holes and install anchors in concrete
- Identify different types of ring gaskets used in flanged connections
- Given a copy of the "Safe Work Process", discuss the correct procedure for opening a service line
- Given a gasket cutter and different types of material, cut two or three flat ring gaskets
- Given a gasket cutter and hole punch, cut a full-face gasket to fit a flange
- Given a gate valve, correctly cut a bonnet gasket
- Identify different types of packing used in industry
- Given a pump or Packing Demonstrator, remove the old packing
- Given a pump or Packing Demonstrator, correctly clean the stuffing box, gland follower, and shaft
- Given a pump or Packing Demonstrator, measure the stuffing box to determine the correct size and number of packing rings to use
- Given a packing cutter, packing, pump or Packing Demonstrator, correctly cut the packing and install it in the pump
- Given a pump or Packing Demonstrator and proper tools, correctly adjust the packing ring the correct tightening sequence
- Given a gate valve and packing, remove the old packing, clean the stuffing box, select the correct packing and install it in the valve
- Given a Piping & Instrumentation Diagram (P & ID drawing) be able to locate Line
- Classification Numbers for a particular process system
- Using a Line Classification Number be able to explain what each element of the Number represents
- Identify the Piping Specification Number included in the Line Classification Number
- Locate a Piping Specification by using Engineering Standards
- Using the Piping Line Classes Standard identify the piping standard for a particular material group

- Using a Piping Specification determine the materials needed for flange assembly
- Identify flange assembly types
- Using a Piping Specification Standard, determine the materials needed for flange assembly
- Correctly disassemble a flanged pipe connection
- Correctly assemble a flanged pipe connection following the Bolt Torque Procedure

Lab Hours: 16

Threaded Piping Systems
NSCC1005508

Lab Objectives

The following is a list of objectives for the Threaded Piping Systems Lab:

- The student will be able to identify each and describe the following:
  - ♦ Black iron, stainless, galvanized pipe
  - ♦ 45 and 90 degree elbows
  - ♦ Tees and crosses
  - ♦ Reducers and bushings
  - ♦ Caps and plugs
  - ♦ Flanged joints
- Determine the correct thread engagement for different fittings
- Identify the material, schedule, and size of a pipe by measuring and using tables in the reference materials provided
- Safely and successfully assemble pipe nipples and pipe fittings
- Demonstrate the ability to tape the pipe correctly
- Safely and correctly use pipe wrenches to assemble the pipe and fittings
- Explain the use of Engineering Standard 15480.G150. Explain that this standard will not be used in this class due to lack of ventilation.

Note: Use of zinc to coat exposed threads requires approval of division supervision and the Safety Department prior to use. Use of zinc could have been hazardous when used in aerosol form over a period of time. The use of a filter is recommended in enclosed areas.

- Safely and correctly cut, ream, and thread pipe using the following tools:
  - ♦ Hand pipe cutter
  - ♦ Hand pipe reamer
  - ♦ Hand threader (ratchet threader) and dies
  - ♦ Assorted sizes of pipe wrenches
  - ♦ Pipe vises
- Safely and correctly cut, ream and thread pipe using the following power shop equipment:
  - ♦ Shop band saw
  - ♦ Shop pipe machine (with cutter, reamer, oil feed, and thread dies)
- Demonstrate the ability to cut pipe to the correct length following all safety regulations and practices
- Demonstrate the ability to safely and correctly thread the pipe using the pipe machine and hand tools

- Safely and correctly use pipe wrenches to assemble the pipe and fittings (using threaded pipe, pipefitting, and pipe vises)
- Safely assemble and disassemble a flanged joint (using combination wrenches)
- Given a figure panel containing different piping sketches and the piping jigs in Mechanical Lab 123, assemble the piping systems represented in the sketches using the Frankland "The Pipe Fitter's and Pipe Welder's Handbook", Anvil's "Pipe Fitters Handbook", and Reference Panel 1 and 2.
- On completing the assigned exercises, the student will have a working knowledge of assembling the following:
  - ♦ Straight runs of pipe
  - ♦ Pipe runs with 90 degree turns
  - ♦ Pipe runs with 45 degree offsets
  - ♦ Pipe runs with 45 degree rolling offsets
  - ♦ Installing valves and unions in threaded systems
  - ♦ Pipe runs with flanged joints
- On completing the different exercises given by the instructor, the student will be able to make a piping sketch with the correct dimensions and symbols.
- Upon completion of this module, the student will have an understanding of Engineering Standard 15480.1000 relating to piping supports as listed in the Reference Panels.

Lab Hours: 20

Hose & Tubing
NSCC1003D21

Lab Objectives

The following is a list of objectives for the Hose & Tubing Lab:

- Given a section of rubber hose, a shoe knife, and a rule, measure and cut the hose to a specified length with a tolerance of ± 1/8 inch
- Given a section of hose and access to a belt sander, square the ends of the hose to a tolerance of ± 1/16 inch
- Given a section of hose and a barbed type Hansen quick disconnect coupling, install the fittings in the hose ends so that the ends of the hose are flush with the fitting flange or stop. Allow no more than a 1/16 inch gap at any one point for the hose being out of square.
- Given a T301 Band-It Tool, preformed center punch type clamps, and a section of hose with fittings installed, clamp the hose to the fittings following manufacturer's instructions
- Given a section of Type L copper tubing, tubing fittings, and steel wool or emery cloth, prepare tubing and fittings to be soldered
- Given a propane torch, a bottle of propane gas, a striker, leather gloves, and safety glasses, assemble and light the torch in a safe and correct manner
- Given properly prepared tubing and fittings, and a propane torch, assemble and solder the joints
- Given a section of copper and stainless tubing, a tubing bender, and a rule bend the tubing at various angles so as to have the bends at a specified distance from the end of the tubing or the center of another bend to a tolerance of ± 1/8 inch
- Given a section of copper tubing, compression and flare type connectors, drawings, and access to the proper tools and equipment, fabricate and install the tubing in a practice frame to a tolerance of ± 1/8 inch

Lab Hours: 20

Steam Systems
NSCC1003D27

Lab Objectives

The following is a list of objectives for the Steam Systems Lab:

- Assist in starting the Amatrol Steam System and produce steam at a sufficient pressure to complete the study of Steam Traps
- Be mindful of the hazards associated with working with Steam and Steam Systems components (Safety Reviews) Use an Infrared Pyrometer, Stethoscope and Ultrasonic Sound Detector to verify the proper operation of various Steam Traps
- Use the above mentioned equipment to determine improper operating Steam Traps
- Review the installation and operation of Contro Tracing on process piping
- Successfully blowdown the Amatrol Steam System and secure the test stand

Lab Hours: 8

Metallic Materials
NSCC1003D24

Lab Objectives

The following is a list of objectives for the Metallic Materials Lab:

- Given various samples of metals, the student will be able to identify each by use of a Color Code Chart and by their physical structure
- Given samples of selected metals and the appropriate tools, the student(s) will be able to saw, file, drill, and tap these metals while demonstrating proper safety methods

Lab Hours: 4

Mechanics & Rigging
NSCC1003D1E

Lab Objectives

The following is a list of objectives for the Mechanics & Rigging Lab:

- Fabricate a sling and assemble thimble eyes on each end of a 1/4” wire rope, correctly installing 1/4” U-Bolt clips according to JTS Basic Rigging Training Manual
- Correctly tie a Square knot, two Half Hitches, Bowline knot, Timber Hitch, Sheet Bend, and Clove Hitch according to JTS Basic Rigging Training Manual
- Install a beam clamp correctly, following the basic rules in the JTS Basic Rigging Training Manual
- Perform a chain hoist safety inspection, following the basic rules in the JTS Basic Rigging Training Manual

- Install a half ton chain hoist safely, following guidelines in the JTS Basic Rigging Training Manual
- Use a permanent structure to safely install a lever hoist, and to lift a Load H-Beam
- Use a Gantry Crane, Chain Hoist, and Lever-Operated Hoist to lift and pull a pump
- horizontally
- Use Mighty Movers to move a pump across the floor
- Select the correct sling and use it safely for a drifting job
- Using a Gantry Crane, drift a pump using rigging accessories such as; shackles, slings,
- beam clamps, and chain hoists
- Demonstrate Rigging Hand Signals and Verbal Commands
- Using an Air Hoist, lift a section of pipe

Lab Hours: 8

Blueprint Reading and Sketching
NSCC1005522

Lab Objectives

The following is a list of objectives for the Blueprint Reading and Sketching Lab:

- Given a blueprint, the student will be able to:
- Locate, identify, and interpret the title, bill of material, and revision blocks
- Locate and identify critical information about the object such as location of various parts of the overall project, floor elevations, and associated drawings with related information
- Given an assortment of various shapes of wooden blocks, sketch pad and pencil; sketch
- the objects in orthographic format
- Successful completion of this course will enable the student to:
- Read and interpret simple prints
- Read and interpret plan and elevation prints
- Read and interpret equipment layout prints
- Read and interpret prints of machine parts
- Identify different areas on a print
- Make a 3-view sketch of an object
- Dimension sketches

Lab Hours: 4

Precision Measuring
NSCC1003D41

Lab Objectives

The following is a list of objectives for the Precision Measuring Lab:

- Given an outside vernier micrometer, accurately measure outside diameters of machine parts to a tolerance of +/- .0001”
- Given a depth micrometer, accurately measure depths of machine parts bores to a tolerance of +/- .001”
- Given an optical flat, measure the flatness of a mechanical seal
- Given a machinist level and a surface plate, level a machine part with the aid of shims
- Given a dial caliper, accurately measure outside and inside dimensions of machine parts to a tolerance of +/- .001”
- Given a dial indicator, check run out, end play and deflection of a shaft
- Given a telescoping gauge, accurately measure various inside diameters and record the measurement with the aid of an outside micrometer
- Given a feeler gauge, accurately measure the clearances of various items
- Given an inside micrometer, accurately measure inside dimensions of machine parts to a tolerance of +/- .001”
- Given a shaft to measure, select the appropriate precision tools addressed in Module One and Two, and accurately measure the shaft to a tolerance of +/- .001”

Lab Hours: 12

Shaft Couplings
NSCC1003D95

Lab Objectives

The following is a list of objectives for Shaft Couplings Lab:

- Identify the following types of couplings:
  - ♦ Flexible Sleeve Coupling – (Woods)
  - ♦ Flange Coupling
  - ♦ Elastomer Spacer Coupling – (Omega 4) and Falk R31
  - ♦ Gear Coupling
  - ♦ Flexible Disc Coupling – (Thomas)
  - ♦ Grid Coupling – (Falk)
  - ♦ Chain Coupling
- Install the following types of couplings:
  - ♦ Woods Sure-Flex #5 SC ‘Dropout’ Coupling
  - ♦ Steelflex ‘Dropout’ Grid Coupling T31

  Rexnord Omega 4 Elastomer Coupling

  Falk R31 Elastomer Spacer Coupling

  Thomas Flexible Disc Coupling, size 150

Lab Hours: 4

Belts and Pulleys; Chains and Sprockets
NSCC10012B2

Lab Objectives

The following is a list of objectives for Belts and Pulleys; Chains and Sprockets Lab:

- Given an Emerson Power Transmission Catalog, and IPT Industrial Trades Training Manual, correctly identify belt drive systems and their component parts
- Given a specified set of sheaves and dimensions, correctly calculate the correct belt size and length
- Using the Lab-Volt Mechanical Trainer, correctly install sheaves and belt(s) in accordance to ANSI recommended specifications
- Using the Lab-Volt Mechanical Trainer, correctly align the drive members of a belt drive system
- Using the Lab-Volt Mechanical Trainer with sheaves and belt installed, and a belt tensioning tool, correctly set the belt tension to within manufacturer's specifications
- Given an Emerson Power Transmission Catalog, an IPT Industrial Trades Training Manual, correctly identify chain drive systems that include roller, multiple-strand and silent chain
- Given a specified set of sprockets and dimensions, correctly calculate the correct chain size and length
- Identify the component parts of a chain drive system that includes sprockets and hubs
- Using the Lab-Volt Mechanical Trainer and chain and sprockets, correctly install and align the drive members of a chain drive system
- Given a selection of sample chain, examine the various chains and determine the types
- Using the Lab-Volt Mechanical Trainer, a set of chain sprockets and roller chain, correctly set the chain sag to within 2-3% of the shaft's center to center dimension

Lab Hours: 12

Industrial Hydraulic Power
NSCC10045D8

Lab Objectives

The following is a list of objectives for Industrial Hydraulic Power Lab:

- To become familiar with the Lab-Volts Hydraulics Trainer. To identify the various system components and to be aware of the safety rules to follow when using the Trainer.
- Investigate a hydraulic circuit and to raise a load using a small hydraulic cylinder
- Introduce the operation of a relief valve
- Establish the oil flow path in a circuit using a pressure relief valve
- Connect and operate a circuit using a pressure relief valve
- Verify the formula F = P x A using a cylinder and a load spring
- Discover what happens to a cylinder when equal pressure is applied to each side of its piston
- Explain the concept of pressure distribution in a cylinder in equilibrium of forces

- Describe the operation of a flow control valve
- Establish the relationship between flow rate and velocity
- Operate meter-in, meter-out, and bypass flow control circuits
- Define the terms “work” and “power”
- Establish the relationship between work, force, and power
- Calculate the work, power and efficiency of a hydraulic system
- Learn how to control the direction, force, and speed of a cylinder
- Introduce the operation of a directional control valve
- Describe the effect a change in system pressure or flow rate has on the speed of a cylinder
- Describe the effect of a change in system pressure or flow rate has on the force exerted by a cylinder
- Describe the design and operation of a hydraulic motor
- Calculate the torque and speed of a hydraulic motor
- Determine the effect a change in flow rate or pressure has on motor operation
- Describe the basic operation of a hydraulic pump
- Use manufacturer pump specifications to test a pump in a hydraulic system
- To explain how oil temperature affects flow rate and volumetric efficiency

Lab Hours: 12

Thermal Cutting Processes
NSCC1009007

Lab Objectives

The following is a list of objectives for Thermal Cutting Processes Lab:

- Safely perform thermal cutting operations in a maintenance environment
- Assemble, operate and disassemble Oxy fuel cutting equipment
- Assemble, operate and disassemble Air Carbon Arc cutting equipment
- Assemble, operate and disassemble Plasma Arc cutting equipment
- Layout and cut plate and various forms of structural steel with thermal cutting equipment
- Set-up and use straight edge guides and circle cutting guides
- Use thermal cutting equipment to gouge metal

Lab Hours: 16

Rotalign Laser Alignment
NSCC100143A

Lab Objectives

The following is a list of objectives for Rotalign Laser Alignment Lab:

Given a Rotalign Ultra Laser Alignment Unit and two machine shafts, be able to align the machine shafts to the tolerances listed in the table. The student will be able to do the following: (Use pump/motor units to deliver training.)

- Determine if the machine has a solid foundation, excessive coupling play, excessive
- shaft play, soft foot, or piping strain before attempting an alignment
- Mount the laser and prism on the two machine shafts so that they are aligned with each other
- Select the correct application in the Rotalign system for performing a horizontal machine alignment
- Enter the correct machine dimensions for an alignment into the Rotalign Computer
- Set the Rotalign system so that it will make alignments to the tolerances listed in the “Excellent” table
- Adjust the laser and prism so that the laser beam is reflected into the measuring range of the position detector
- Measure the alignment of the two machine shafts
- Determine the foot corrections necessary for the front and back feet of the “Machine To Be Moved” (MTBM)

Lab Hours: 12

Bearing & Oil Seals Lab
NSCC10012B0

Lab Objectives

The following is a list of objectives for Bearings & Oil Seals Lab:

- Given a laptop and a “Bearing Manual DVD”, the student will be able to identify various types of bearings and oil seals
- Given a laptop, a “Bearing Manual DVD” and an assortment of bearings, the student will be able to decode the various manufacturer symbols and then cross-reference from one bearing manufacturer to another
- Given a laptop, a “Bearing Manual DVD”, an assortment of bearings, and various measuring instruments, the student will be able to locate and cross-reference a bearing by using dimensions
- Given a laptop, a “Bearing Manual DVD”, seal housing, pump shaft, and various measuring instruments, the student will be able to locate and cross-reference a seal by using dimensions
- Given a laptop, a “Bearing Manual DVD” and various seal manufacturers’ names and seal numbers, the student will be able to locate and cross-reference the seals between different manufacturers
- Given a laptop, a “Bearing Manual DVD” and using the Educational Section as a reference, the student will be able to select the proper tools for the removal, inspection and installation of specific bearings and oil seals
- Given access to a hydraulic press and a pump shaft with bearings installed, the student
- Given access to an induction heater, pyrometer, bearing puller, and a pump shaft with bearings installed, the student will be

able to safely and correctly pull the bearings from the shaft and replace them using the induction heater

- Given access to a hydraulic press, bearing covers, and seal driver, the student will be able to safely and correctly remove and replace an oil seal

Lab Hours: 12

Fundamentals of Problem Solving & Troubleshooting – Mechanical
NSCC10083D1

Lab Objectives

The following is a list of objective(s) for Fundamentals of Problem Solving & Troubleshooting – Mechanical:

- Conduct a valid and reliable "Troubleshooting Process", the process can then be used to isolate the malfunction in most mechanical, electrical & instrument systems

Lab Hours: 24

Gears
NSCC100456F

Lab Objectives

The following is a list of objectives for Gears Lab:

- Using the DAC Gear Maintenance Trainer, spur gears, the acrylic gear sample, and the IPT Industrial Trades Manual, identify:
  - ♦ Common components
  - ♦ Construction features
  - ♦ Terminology
  - ♦ Concepts
- Using the IPT Trades Manual, as well as the spur gears and helical gears included with the training aid, identify terminology and features associated with parallel shaft gearing
- Using the IPT Industrial Trades Manual, a magnetic base/dial indicator set, dial calipers, shafts, and spur gears included with the training aid, install spur gears in training aid and align the spur gear to manufacturer's specification
- Using the IPT Industrial Trades Manual, and the tapered roller bearings included with the training aid, identify terminology and procedures for installing taper lock roller bearings
- Using the IPT Industrial Trades Manual, a magnetic/dial indicator set, shafts, and helical gears included with the training aid, install helical gears in training aid and align helical gears to specification

Lab Hours: 16

Mechanical Seals/Centrifugal Pumps Lab
NSCC10012C3

Lab Objectives
The following is a list of objectives for Mechanical Seals/Centrifugal Lab:

- Define a mechanical seal
- Explain why a mechanical seal is used over compression packing
- Explain the difference between a Single Component Seal and a Single Cartridge Seal
- Learn how a mechanical seal works and what they look like
- Learn what can happen between the stationary and rotary faces
- Learn how fluid film helps between the seal faces
- Correctly install and remove a cartridge seal using a variety of hand tools
- Learn about Double Seals, how they work and why they're used
- Learn about Barrier Fluids and Buffer Fluids and when they're used
- Learn about environmental controls
- Learn about the common types of mechanical seals
- Using Lab-Volts Pump Training System the student will be able to learn how to start-up, operate, and troubleshoot centrifugal pumps
- Using Lab-Volts Pump Training System the student will be able to measure frequency, voltage, speed, pressure, and flow rate of centrifugal pumps
- Given a centrifugal pump and a manufacturer "Maintenance Manual", the student will be able to correctly identify the components of the pump
- Given a centrifugal pump, a manufacturer "Maintenance Manual", and an assortment of measuring instruments, the student will be able to set up and check the following pump specifications:
    - ♦ Impeller clearance
    - ♦ Shaft runout
    - ♦ Shaft end play
    - ♦ Shaft deflection
- Given a centrifugal pump, a manufacturer "Maintenance Manual", and an assortment of tools, the student will be able to safely and correctly remove the power end of the pump
- Given a centrifugal pump power end, manufacturer "Maintenance Manual", and an assortment of tools, the student will be able to safely and correctly disassemble and inspect the components
- Given the correct components or using the existing components, a manufacturer "Maintenance Manual", and an assortment of tools, the student will be able to safely and correctly assemble the power end of a centrifugal pump
- Given the power end of a centrifugal pump and an assortment of tools, the student will be able to safely and correctly install the power end into the case
- Given a centrifugal pump and manufacturer "Maintenance Manual", the student will be able to review the start-up procedures for the pump

Lab Hours: 16

Positive Displacement Pumps Lab
NSCC1004808

Lab Objectives

The following is a list of objectives for Positive Displacement Pumps Lab:

- Given a Pneumatic Diaphragm Pump and a Lab-Volt Work Order, the student will be able to correctly disassemble, inspect, and reassemble the pump
- Given an External Gear Pump and a Lab-Volt Work Order, the student will be able to correctly disassemble, inspect, reassemble, operate, and troubleshoot the pump
- Given a Piston Pump and a Lab-Volt Work Order, the student will be able to correctly lubricate, install, operate, and troubleshoot the pump
- Given a Vane Pump and a Lab-Volt Work Order, the student will be able to identify the components, install, operate, and troubleshoot the pump
- Given a Vickers V10 Vane Pump and a service/parts manual, the student will be able to correctly disassemble, inspect, and reassemble the pump for either left or right hand rotation
- Given a Viking Model F432 Pump and a service/parts manual, the student will be able to correctly disassemble, inspect, and reassemble the pump
- Given a Vickers V2010 Vane Pump and a parts manual, the student will be able to correctly disassemble, inspect, and reassemble the pump for either left or right hand rotation

Lab Hours: 12

Welding Fundamentals Lab
NSCC1004896

Lab Objectives

The following is a list of objectives for Welding Fundamentals Lab:

- Set up a DC welder properly
- Set up a DC welder for the proper current range for 1/8” E308L electrode
- Set up the proper current range for 3/32” E7018 electrode
- Set up the proper current range for 1/8” E7018 electrode
- Set up a DC welder for the proper current range for 3/32” E316L electrode
- Explain how to sharpen tungsten for welding steel
- Set up proper current range for TIG welding steel
- Explain how to prepare tungsten correctly for welding Aluminum
- Set a TIG welder to STRAIGHT polarity
- Explain the difference between a wet-head and a dry-head
- Explain how to set up TIG welder for welding Aluminum
- Know the proper cup size for welding Aluminum

Lab Hours: 16

Equipment Installation Lab
NSCC1003D23

Lab Objectives

The following is a list of objectives for Equipment Installation Lab:

- Given a drawing of a building's Floor Plan, identify a particular location in the building
- Using a building drawing and a set of instructions, locate the base line for setting a piece of equipment
- Using a building drawing and a set of instructions, lay out centerlines for setting equipment to a tolerance of ± ¼"
- Using a building drawing and a set of instructions, lay out the bolt holes for setting equipment to a tolerance of ± ¼"
- Using a building drawing and a set of instructions, correctly set a piece of equipment according to the instructions
- Using a Water Level, accurately transfer elevations to a tolerance of ± 1/8" and calculate the new elevation of a given point
- Using a Transit, accurately transfer elevations to a tolerance of ± 1/16" and calculate the new elevation of a given point
- Using an Automatic Level and Leveling Rod, calculate distances of given points
- Using a Laser Distance Measure, determine distances of given points
- Given a Water Level, set up and align bearing blocks on portable frames to a tolerance of ± 1/8"
- Given a Transit, set up and align bearing blocks on portable frames to a tolerance of ± 1/8"

Lab Hours: 12

Heat Exchanger Lab
NSCC10012C7

Lab Objectives

The following is a list of objectives for Columns and Heat Exchangers Lab:

- Given correct reference information and proper tools, the student will be able to select and install heat exchanger tubes
- Using manufacturers information and given a tube expander, the student will be able to roll a 3/4" tube to the proper specifications
- Given a collapsing tool, the student will be able to safely collapse a ¾" copper tube and remove tube
- Given a pneumatic chipping hammer and tube drift, the student will be able to remove stainless steel heat exchanger tube
- Given manufacturers reference material, the student will be able to select the correct tapered plugs for stopping tube leakage
- Using TED Vessel Site Practices handout, "Nameplates" and TED Heat Exchanger Shell/Tube Test Drawings pertaining to hydrostatic pressure testing, the student will learn how to inspect for leaking tubes in heat exchangers

Lab Hours: 8

Welded Pipe Lab
NSCC10012B8

Lab Objectives

The following is a list of objectives for Welded Pipe Lab:

- Given a piping specification, correctly utilize the correct specification and details for a specific piping application
- Given a piping situation, accurately draw an isometric sketch of a piping system using the necessary piping symbols and the correct drafting procedure.
- Given a piping situation, accurately measure the piping system to be fabricated to within ±1/8”
- Correctly dimension a piping isometric sketch according to Industry Standards.
- Using an isometric piping sketch, accurately determine the cut lengths for the pipe to within ± 0”
- Using an isometric sketch, accurately determine all materials required for fabrication and installation of the piping system.
- Given a piping specification code, accurately fabricate a three-flange pipeline to within a tolerance of ± 1/8” using the correct specification materials, flange setback allowance, and pipe setback for socket weld fittings.
- Given a flange tree, correctly install a three-flange pipeline.
- Correctly calculate the correct lengths of a pipe for a simple offset.
- Correctly calculate the correct lengths of a pipe for a rolling offset.
- Given a particular piping situation, accurately prepare an isometric sketch of a simple and a rolling offset.
- Correctly bevel pipe with either a pipe machine beveller or a side grinder.
- Given a piping situation, accurately measure the piping system with a simple offset to within ± 1/8”.
- Correctly draw and dimension an isometric sketch of a simple offset according to standards.
- Given a particular piping situation with a simple offset, accurately determine the cut lengths of pipe to within ± 0” using the correct weld gap.
- Correctly fabricate and install a two-flange pipeline with a simple offset according to standards.

Lab Hours: 20

Basic Welding

NSCC11242260

Lab Objectives

Safety: 10 Hours

- Class introduction and gear check
- RCAM walk-through
- General safety
- Shop safety
- Welding specific

Machine Set Up & SMAW Theory: 10 Hours

- SMAW theory
- Electrode selection
- Material selection & preparation
- Machines
- Set up
- Troubleshooting
- Introduction to hand tools

SMAW Practical: 40 Hours

- Flat
- Horizontal
- Vertical
- Overhead
- Butt
- Lap
- Other

Lab Hours: 60

Intermediate Welding

NSCC11242290

Lab Objectives

Safety: 10 Hours

- Class introduction and gear check
- RCAM walk-through
- General safety
- Shop safety
- Welding specific

Machine Set Up & SMAW Theory: 10 Hours

- SMAW theory
- Electrode selection
- Material selection & preparation
- Machines
- Set up
- Troubleshooting
- Introduction to hand tools

SMAW Practical: 60 Hours

- Butt
- Lap
- T joint
- Flat
- Vertical
- Overhead
- V-groove
- Flat
- Vertical
- Overhead
- Pipe
- Horizontal
- Vertical

Oxy Acetylene Cutting: 10 Hours

- Rig setup
- Cutting
- Piercing

Lab Hours: 90

Advanced Welding
NSCC112422120

Safety: 10 Hours

- Class introduction and gear check
- RCAM walk-through
- General safety
- Shop safety
- Welding specific

Machine Set Up & SMAW Theory: 10 Hours

- SMAW theory
- Electrode selection
- Material selection & preparation
- Machines
- Set up
- Troubleshooting
- Introduction to hand tools

SMAW Practical: 60 Hours

- Butt
- Lap
- T joint
- Flat
- Vertical
- Overhead
- V-groove
- Flat
- Vertical
- Overhead
- V groove pipe
- Horizontal
- Vertical

Introduction to GMAW: 5 Hours

- Machine set up
- Pad weld
- T joint
- Flat
- Vertical
- Overhead

Introduction to FCAW: 5 Hours

- Machine set up
- Pad weld
- T joint
- Flat
- Vertical
- Overhead

Introduction to GTAW: 5 Hours

- Machine set up
- Pad weld
- T joint
- Flat
- Vertical
- Overhead

Oxy Acetylene Cutting: 10 Hours

- Rig setup
- Cutting
- Piercing

Arc Gouging: 5 Hours

- Machine set up
- Electrode selection
- Gouging
- Flat
- Vertical
- Overhead

Fundamentals of Fabrication: 10 Hours

- Tools and their uses
- Stepped planning
- Fundamentals of welding math
- Practical use

Lab Hours: 120

INSTRUMENTATION

Basic Instrumentation Overview
NSCC1007791A

Lab Objectives

The following is a list of objectives for Instrumentation Overview Lab:
The successful manufacture of Quality products by a manufacturer is heavily dependent on the sensing and control of the many process variables which make up their production processes. This lab will give you a basic overview of how various process variables are measured, transmitted, controlled and how the individual components work together to form the "control loops" used by manufacturers to produce their products.

- Observe the flow (process variable) of product (dark green liquid) through the tubes
- Observe the flow (manipulated variable) of cooling/heating medium (light green liquid) through the shell
- Observe the pressure and flow from a centrifugal pump using a Speed Control on the pump motor to control flow
- Observe and operate three single loop measurement/control functions:
    - ♦ Level measurement and control
    - ♦ Flow measurement and comparison of two flow device
    - ♦ Pressure measurement and recording

Lab Hours: 4

Instrument Fundamentals
NSCC1007791

Lab Objectives

The following is a list of objectives for Instrument Fundamentals Lab:
Perform conversions between:

- ♦ PSI
- ♦ Inches H20
- ♦ Millimeters of Mercury
- ♦ Inches of Hg
- ♦ Absolute pressure
- ♦ Gauge pressure
- Calibrate an electronic analog transmitter
- Install the transmitter on the Water Process Simulator in a control loop and control the pressure at the desired set-point
- Define terminology associated with level and level measurement concepts
- Recall the instrumentation and methods used to measure level
- Identify direct and indirect level devices

- Measure level of tank and compare to transmitter reading
- Observe operation of a bubbler system
- Define the term delta P
- List some devices that use this principle to measure flow
- Convert delta P values into actual flow rates as the flow is varied on a process simulator,
- given the mathematical formulas
- Identify the four scales to measure temperature and be able to convert from one
- temperature scale to another
- List and describe the operation of three temperature-filled systems and state how remote
- temperature measurement is made possible
- Identify several types of thermocouples and determine the correct polarity of each
- Recall how to check the condition of a thermocouple
- Identify the parts and construction of various RTDs and thermistors, and recall how they
- measure temperature
- State how resistance readings are taken from RTDs and thermistors
- Identify thermocouples, measure their outputs, interpret their reference charts, and make
- jack connection
- Identify resistance temperature detectors (RTDs), measure their outputs, and interpret their
- temperature conversion charts

Lab Hours: 20

Control Valves
NSCC1001382

Lab Objectives

The following is a list of objectives for Control Valves Lab:

- Disassemble, inspect, and reassemble a diaphragm/cylinder actuated control valve
- Perform maintenance on a control valve
- Adjust a diaphragm/cylinder actuated control valve to the manufacturer's specifications
- Mount a pneumatic valve positioner on a diaphragm/cylinder actuated control valve
- Calibrate a pneumatic valve positioner to the manufacturer's specifications
- Perform minor maintenance on a current to pressure (I/P) transducer
- Verify proper operation of the transducer
- Hook-up a current to pressure (I/P) transducer to necessary air supply and use it supply a
- proper signal to the positioner to stroke either a cylinder/diaphragm operated control valve
- Identify the type of ¼ turn valve, the method of converting linear motion to rotary motion.
- i.e. rack and pinion, scotch yoke etc.
- Hook-up and calibrate a rotary motion positioned control valve
- Make a determination as to the cause a rotary valve doesn't track the incoming instrument signal properly

Lab Hours: 16

Pressure Measurement
NSCC10012D5

Lab Objectives

The following is a list of objectives for Pressure Measurement Lab:

This course consists of hands-on lab exercises designed to assist the student to obtain the skills and knowledge necessary to perform calibration, understand basic control fundamentals and limited troubleshooting procedures on various types of pressure measuring instruments.

- Common test equipment will be used to provide calibration standards.
- Given an assortment of elastic deformation pressure elements, identify diaphragm elements, pressure capsules, bellows, and bourdons
- Given an electronic differential pressure transmitter, test equipment, a manufacturer's manual, and hand tools, calibrate the transmitter to manufacturer's specifications
- Given the physical appearance and the data gathered during the calibration procedure for each of the measuring instruments calibrated, determine the operational condition of the instrument
- Using the manufacturer's manual, perform an upscale and downscale calibration check on the measuring instrument listing the as found condition on the instrument history report
- Determine the accuracy of the measuring instrument using the as-found data/condition instrument history report
- Given an electronic absolute pressure transmitter, test equipment, a manufacturer's manual, and hand tools, calibrate the transmitter to manufacturer's specifications

The trainee will be introduced to the dynamics of process control systems, open-loop and closed loop processes, block diagrams and various types of processes.

- Feedback control
- On-Off control
- PID control
- Proportional controller
- Proportional and Integral controller
- Proportional, Integral and Derivative controller
- Proportional and Derivative controller
- Comparison between the P, PI and PID control
- The Proportional, Integral and Derivative action

Lab Hours: 16

Liquid Level Measurement
NSCC1001327

Lab Objectives

The following is a list of objectives for Liquid Level Measurement Lab:

- Understand Level Measurement of a Pressurized Vessel using a wet leg reference

- Understand and be able to set-up differential pressure transmitters for level measurement of both closed and open vessels
- Basic understanding of the open-loop method of controller tuning
- Understand the open-loop Ziegler-Nichols method

Lab Hours: 8

Fluid Flow Measurement
NSCC1001328

Lab Objectives

The following is a list of objectives for Fluid Flow Measurement Lab:

This is the second in a series of four courses which reinforces the concepts of measurement, calibration and introduces the student to Controllers, Process Control, Control Loops and Fundamental Control Troubleshooting. This second course consists of hands-on lab exercises designed to assist the student to obtain the skills and knowledge necessary to perform configuration of a differential pressure transmitter to measure flow from pressures derived from an orifice plate and or venturi tube.

- Brief review of new control modes
- Tuning with the Ziegler-Nichols ultimate-cycle method
- Limits of the ultimate-cycle method

Lab Hours: 8

Temperature Measurement
NSCC1001329

Lab Objectives

The following is a list of objectives for Temperature Measurement Lab:

- Recall the terminology associated with temperature and temperature measurement, and become familiar with the instruments used to measure temperature
- Review identifying thermocouples, how to measure their outputs and interpret their reference charts
- Review identifying resistance temperature detectors (RTDs), how to measure their outputs and interpret their temperature conversion charts
- Setup and bench calibrate a smart temperature transmitter and correctly document the transmitter's specifications acquired from the transmitter's internal memory and nameplate data using both a hand-held communicator and a lap-top PC running HART protocol software
- Perform a Guided Process Control Troubleshooting Process and apply it to a "control problem" to troubleshoot the problem to the root cause

Lab Hours: 8

Digital Instruments
NSCC10013B6

Lab Objectives

The following is a list of objectives for Digital Instruments Lab:

- Upon completion of this module, the trainee should have a better understanding of both Hart and Foundation Fieldbus Protocols
- Configure and calibrate a Rosemount 3051S Series Smart Transmitter to manufacturer's specifications (HART Protocol)
- Configure and calibrate a Rosemount 5400 Series Radar Level Transmitter to manufacturer's specifications (HART Protocol)
- Configure and calibrate a Rosemount 3100 Series Ultrasonic Level Transmitter to manufacturer's specifications (HART Protocol)
- Configure and calibrate a Rosemount 8800 Series Vortex Flow Transmitter to manufacturer's specifications (HART Protocol)
- Configure and calibrate a Rosemount 8700 Series Magnetic Flow Transmitter to manufacturer's specifications (HART Protocol)
- Configure and calibrate an Endress+Hauser Promass 83 Coriolis Transmitter to manufacturer's specifications (Foundation Fieldbus Protocol)
- Configure and calibrate an Endress+Hauser Deltabar S DP Transmitter to manufacturer's specifications. (Foundation Fieldbus Protocol)
- Configure and calibrate a Fischer "Smart" Control Valve (both Hart and Foundation Fieldbus) to manufacturer's specifications
- Using an Allen-Bradley Control Logix PLC establish control of a level and flow loop in the following modes of control:
  - ♦ On-Off
  - ♦ PID
  - ♦ Cascade

Lab Hours: 32

Electronic Loop Troubleshooting
NSCC10047E4

Lab Objectives

The following is a list of objectives for Electronic Loop Troubleshooting Lab:

- Review Series Loop Structure
- Review ISA Standard Symbols
- Review voltage, current and continuity measurement
- Review five step troubleshooting process
- Utilize a systematic approach to troubleshoot single-loop control systems to develop your troubleshooting skills via a guided troubleshooting exercise
- Allow the trainee to experience several problem solving/ troubleshooting exercises without any guidelines

Lab Hours: 16

PLC Fundamentals
NSCC1007A44

Lab Objectives

The following is a list of objectives for PLC Fundamentals Lab:

- Review PLC basics: architecture, PLC system, memory organization, types of files, program scan, programming language, RS Logix®, I/O configuration, and modes of operation
- Revise PLC relay-type instructions and download and test a PLC ladder program that uses relay-type instructions to control the turning on and turning off of two pilot lamps
- Revise PLC timer instructions and download and test a PLC ladder program that uses timer-on instructions to turn on three pilot lamps in a programmed order and for a definite period of time
- Revise PLC counter instructions and download and test a PLC ladder program that used counters in cascade
- Perform an initial communications setup for a SLC 500 using RS Logix® software with a 1743-CP3 cable using a laptop PC and the serial Com Port 1 of the PC (establishing and deleting the program multiple times)
- Download a PLC program from a flash memory card
- Revise PLC latching and comparison instructions and download and test a PLC ladder program that uses latching and counter-driven comparison instructions
- Connect and test a PLC-controlled hydraulic system that continuously reciprocates a cylinder and makes it dwell (wait) in two predetermined positions for some period of time
- Connect and test a PLC-controlled hydraulic system that makes a motor rotate 200 turns and then reciprocates a cylinder five times
- After review of “A Troubleshooting Process”, the participants will be given various faults to troubleshoot and correct in the Exercise Six lab setups for the balance of the remaining time of the hands-on lab

Lab Hours: 16

ELECTRICAL

Industrial Electricity: Basic Principles
NSCC10080B2

Lab Objectives

The following is a list of objectives for Industrial Electricity: Basic Principles Lab:

- List types of electricity and the two main types of electrical current
- Identify resistor values using the resistor color code
- Calculate power in a simple electrical circuit
- State the direction of electron current flow
- State which materials are good conductors
- Identify various switches, such as a normally open pushbutton, a normally closed push button, a selector switch, and a toggle switch
- Explain a short circuit and the role of overload protection
- Define and illustrate current and voltage relationships in Ohm's Law
- Construct a series, a parallel circuit, and series-parallel circuit and measure voltage across, resistance of, and current in the circuit
- Calculate unknown voltage, current, and resistance values in various series, parallel, and series-parallel Ohm's Law problems

Lab Hours: 16

Industrial Electricity: Alternating Current
NSCC10080B3

Lab Objectives

The following is a list of objectives for Industrial Electricity: Alternating Current Lab:

- Describe the advantages of alternating current
- Explain electromagnetic induction
- Describe the components of a sine wave
- Describe alternating current waveforms
- Calculate effective value of a sine wave
- Calculate average value of a sine wave
- Define the terms, units, and symbols associated with inductance and capacitance
- Explain inductance and capacitance and the effects of both on ac circuits

Lab Hours: 8

Industrial Electricity: Conductors & Wiring
NSCC10080B4

Lab Objectives

The following is a list of objectives for Industrial Electricity: Conductors & Wiring Lab:

- Properly solder a connection with the appropriate materials and tools
- Identify several types of wire, and determine the current carrying capability of each
- Given a section of wire, identify its voltage rating
- Properly solder a connection with the appropriate materials and tools
- Identify several types of wire, and determine the current carrying capability of each
- Given a section of wire, identify its voltage rating
- Identify various lugs and connectors and state the application of each
- Strip wire using the appropriate tool
- Make electrical splices using appropriate tools and lugs
- Properly tape an electrical connection
- Locate a lighting panel and/or a power panel directory using the Intranet
- Remove a circuit breaker from a lighting panel
- Install a circuit breaker in a lighting panel
- De-energize and energize a power panel disconnect and a local disconnect
- Properly install/remove fuses from a power panel disconnect
- Properly connect a receptacle and plug to a power cord
- Make the proper connections to a duplex receptacle
- Make the proper connections to a Ground-Fault Circuit-Interrupter (GFCI)
- Explain the operation of a single-pole, three-way, and four-way switch, and hook up combinations of each
- Correctly hook up an incandescent light
- Read and interpret an ampacity table
- Explain grounding, identify proper grounds on electrical equipment, and identify improperly and properly grounded process equipment
- Explain bonding and identify properly bonded process equipment

Lab Hours: 16

Electrical Test Equipment
NSCC1008134

Lab Objectives

The following is a list of objectives for Electrical Test Equipment Lab:

- State the main purpose of a voltage tester

- Identify the parts of a voltage tester
- State the operating principle of a voltage tester
- List the checks to be made to ensure a voltage tester is in good operating condition
- List the warnings involved when using a voltage tester
- List the cautions involved when using a voltage tester
- Use a voltage tester to check an energized/de-energized AC circuit
- Use a voltage tester to check an energized/de-energized DC circuit
- Identify the purpose and features of a clamp-on AMMETER
- State the Safety Information that will ensure safe operation and service of the tester as well as the Cautions and Warnings concerning its use.
- Use a AMMETER to measure current, voltage, resistance, and continuity
- State the purpose of a megohmmeter (Megger)
- Identify the parts and features of a typical megohmmeter (Megger)
- Test a megohmmeter to ensure proper operation
- List safety precautions to be used when using a megohmmeter
- List factors that affect insulation resistance
- Use a megohmmeter to test wiring insulation and motors
- Identify the functions, function buttons, connections, switches, and display of a digital multimeter
- Locate, check, and replace the battery and fuses of a digital multimeter (DMM)
- Use a digital multimeter (DMM):
  - ♦ Measure DC voltage
  - ♦ Measure DC current
  - ♦ Measure AC voltage
  - ♦ Measure resistance
  - ♦ Measure conductance
  - ♦ Test diodes

Lab Hours: 8

Electrical Drawings
NSCC10075C4

Lab Objectives

The following is a list of objectives for Electrical Drawings Lab:

- Identify symbols used in electrical elementary diagrams
- Recognize the difference between schematics and wiring diagrams
- Read electrical elementary diagrams
- Hook-up designed electrical elementary drawings on training simulator
- Given an electrical elementary drawing, revise the drawing according to specified instructions

Lab Hours: 8

Transformers & 3-Phase Electricity Fundamentals
NSCC1008133

Lab Objectives

The following is a list of objectives for Transformers & 3-Phase Electricity Fundamentals Lab:

- State how a transformer operates:
- Calculate primary and secondary voltage
- Calculate primary and secondary current
- Properly connect a single phase transformer
- Properly ground a single phase transformer
- Distinguish single phase ac power from three phase ac power
- Properly connect a three phase transformer
- Properly ground a three phase transformer
- Calculate transformer voltage for various three-phase systems

Lab Hours: 16

Conduit Installation
NSCC10083AA

Lab Objectives

The following is a list of objectives for the Conduit Installation Lab:

- Define conduit
- State the function of conduit
- Explain how conduit is sized
- Identify rigid conduit
- Identify aluminum conduit
- Identify vapor proof conduit (liquid tight)
- Use Engineering Standard ELECF01 A to determine the proper number of conductors allowed for a specific size of conduit
- State the purpose of obround series of condulet fittings
- Identify and state the use of “L” fittings
- Identify and state the use of “C”, “E”, “T”, “TA”, “TB”, and “X” obround fittings
- State the purpose of “F” type series condulet fittings
- Identify “FS” condulet fittings
- Identify “FD” condulet fittings
- State the purpose and identify the following explosion fittings: (GUAB, GUAC, GUAD, GUAM , GUAN, GUAT, GUAW, GUAX,

ECGF, ECLK)

Upon successful completion of this module the trainee will be able to identify and state the function of:

- Junction boxes
- Conduit bushings (male and female)
- Locknuts
- Conduit couplings
- 90 degree elbows
- “EL” condulets
- “PLG” condulet plugs
- “RE” condulet reducer
- Jiffy plugs
- “UNF” conduit unions
- Conduit insulated bushings
- “UNJ” fixture hangers
- PC clamps
- RC clamp
- One hole clamps
- Two hole clamps
- Minerallac clamps
- Sealing fittings
- EYD sealing fittings
- EYS sealing fittings
- EZS sealing fittings:
  - ♦ Measure conduit
  - ♦ Define the “take-up distance” of hand benders
  - ♦ Define “back of the 90” measurement
- Make a “90” bend in conduit
- Cut and thread conduit
- Make an offset bend in conduit
- Make a “kick” in conduit
- Make a “saddle” bend in conduit

Lab Hours: 16

Industrial Electricity: Basic AC Motor Controls
NSCC1008308

Lab Objectives

The following is a list of objectives for Industrial Electricity: Basic AC Motor Controls Lab:

- Describe the function of various types of control devices, including limit switches, flow switches, level/float switches, pressure switches, push button switches, and temperature switches
- State the operating characteristics and applications of control relays
- State the operating characteristics of ON-delay timers
- State the operating characteristics of OFF-delay timers
- Describe the function and operation of various types of overload devices, including thermal and magnetic
- Identify symbols used on electrical schematics and wiring diagrams
- Discuss and perform a lockout/tagout procedure
- Identify the schematic symbols of control devices typically included in a basic motor control circuit
- Identify the schematic symbols for manual starters as well as non-reversing and reversing magnetic starters
- Identify the wire color code for motor control circuits
- Read schematic diagrams of basic motor control circuits
- Construct AC Motor Control circuits using various devices on the Lab-Volt Motor Controls Trainer
- Determine the proper NEMA starter size using motor name-plate ratings
- Determine the proper fuse size using motor name-plate ratings
- Determine the required overload size using the motor name-plate ratings
- Read and draw a basic motor control circuit for a single-phase motor with a manual starter
- Read and draw basic motor control circuits for a non-reversing magnetic starter and a reversing magnetic starter using various pushbuttons, relays, limit switches, and other control devices
- Correctly hook up a single-phase motor with a manual starter
- Correctly hook up a three-phase non-reversing motor control circuit using various push-buttons, relays, limit switches, and other control devices
- Correctly hook up a three-phase reversing motor control circuit
- Given the appropriate test equipment, troubleshoot and repair various motor control circuits
- Lock and tag a local disconnect

Lab Hours: 32

AC/DC Motors
NSCC10042C7

Lab Objectives

The following is a list of objectives for AC/DC Motors Lab:

- Examine the construction of a DC motor

- Measure the resistance of DC motor windings
- Study the nominal current capabilities of various DC motor windings
- Locate the neutral brush position on a DC motor
- Learn basic motor wiring connections
- Observe the operating characteristics of series and shunt connected motors
- Study the torque vs. speed characteristics of a shunt wound, series wound, and compound wound DC motor
- Calculate the efficiency of the shunt wound, series wound, and compound wound DC motor
- Determine the counter-emf in a permanent magnet DC motor
- Learn how to reverse the rotation on DC motors
- Examine the construction of a split-phase motor and measure the resistance of its windings
- Learn the basic motor wiring connections and observe the starting and running operation of the split-phase motor
- Measure the starting and operating characteristics of the split-phase motor under load and no-load conditions, and study its power factor and efficiency
- Measure the starting and operating characteristics of the capacitor-start motor, and compare its starting and running performance with the split-phase motor
- Gain a basic understanding of Universal Motors
- Learn how to reverse the rotation on single phase motors
- Examine the construction of the three-phase squirrel-cage motor, and determine its starting, no-load, and full-load characteristics
- Describe how three-phase motors start and run
- Connect a dual-voltage three-phase motor
- Megger a three-phase motor and associated power wiring
- Measure three-phase motor current while varying the motor load
- Troubleshoot a three-phase motor circuit using appropriate test equipment
- Learn how to reverse the rotation on three-phase motors

Lab Hours: 24

DC Fundamentals
NSCC1003F96

Lab Objectives

The following is a list of objectives for DC Fundamentals Lab:

- Demonstrate the ability to use Ohm's law with circuit measurements
- Measure voltage, current, and resistance in a series circuit
- Troubleshoot a series circuit and determine if a component is opened, shorted, or value has changed and identify that component
- Measure voltage, current, and resistance in parallel circuit
- Troubleshoot a parallel circuit and determine if a component is opened, shorted, or value has changed and identify that component

- Measure voltage, current, and resistance in a series-parallel circuit
- Troubleshoot a series-parallel circuit and determine if a component is opened, shorted, or value has changed and identify that component
- Measure voltages in unloaded and loaded voltage dividers circuits
- Measure voltages drops in a bridge circuit and determine if the circuit is balanced or unbalanced

Lab Hours: 24

AC Fundamentals
NSCC1003F98

Lab Objectives

The following is a list of objectives for AC Fundamentals Lab:

- Given an oscilloscope and a function generator, set up the oscilloscope to read the output (frequency and amplitude) of the function generator
- Explain the meaning of phase angle as it pertains to current lagging or leading voltage
- Define capacitance and its unit of measure
- Identify the schematic symbol for a capacitor
- Explain what happens to capacitance when connected in series or parallel circuits
- Define inductance and its unit of measure
- Identify the schematic symbol for an inductor
- Explain what happens to inductance when connected in series or parallel circuits
- Given a RCL circuit: calculate apparent, active, and reactive power
- Given an RC, RL, or RCL series circuit, identify an open component in the circuit
- Given an RC, RL, or RCL series circuit, identify a shorted component in the circuit
- Given an RC, RL, or RCL series circuit, identify a changed value component in the circuit
- Given an RC, RL, or RCL parallel circuit, identify an open component in the circuit
- Given an RC, RL, or RCL parallel circuit, identify a shorted component in the circuit
- Given an RC, RL, or RCL parallel circuit, identify a changed value component in the circuit
- Given an RC circuit and a multimeter, observe capacitor charging and discharging using the multimeter
- Given an RC circuit, verify RC time constants by use of measurements

Lab Hours: 32

Analog Circuits
NSCC100420E

Lab Objectives

The following is a list of objectives for Analog Circuits Lab:

- Recognize normal operation of a junction diode, limiter circuit, and a clamper circuit
- Measure current through a junction diode
- Observe and identify an open and shorted junction diode
- Measure input/output waveform of a diode limiter and clamper circuits
- Identify faulty limiter and clamper circuits and determine the faulty component
- Correctly connect a LED for normal operation
- Given a transistor amplifier circuit, measure gain
- Given a transistor circuit, observe cutoff and saturation
- Given a transistor circuit, measure collector current with varying load resistor
- Given a transistor circuit, observe and measure input/output waveforms of a common emitter amplifier to determine normal operation
- Given a power supply circuit, identify normal operation of a full, half wave, and bridge rectifier circuit
- Given a power supply, predict and measure the voltage drop of a reverse biased zener diode
- Given a power supply circuit, recognize normal operation of a zener diode
- Given a power supply circuit, measure input/output voltages of a zener diode regulator and voltage regulator
- Given a power supply circuit, recognize normal operation of a zener diode regulator and a voltage regulator
- Given a power supply circuit, recognize that a zener diode voltage regulator and a voltage regulator circuit is faulted
- Given a power supply circuit, observe the effects of a faulted component in zener diode voltage regulator circuit and a voltage regulator circuit
- Recognize the normal operation and faulted operation of a UJT Oscillator circuit
- Recognize the normal operation and faulted operation of an SCR trigger circuit
- Measure waveform in a UJT Oscillator
- Measure the gate and anode current in an SCR trigger operating circuit
- Recognize the normal operation and faulted operation of a 555 Timer
- Observe the effect of AC voltages with basic Diac operation
- Observe the effect of DC voltages with basic Diac operation
- Observe the effect of AC voltages with basic Traic operation
- Observe the effect of DC voltages with a basic Traic operation

Lab Hours: 32

Digital Circuits
NSCC1004625

Lab Objectives

The following is a list of objectives for Digital Circuits Lab:

- Measure input and output waveforms of an AND gate using a logic probe
- Read the truth table for an AND gate
- Measure input and output waveforms of an OR gate using a logic probe
- Read the truth table for an OR gate
- Measure input and output waveforms of a NOT gate using a logic probe
- Read the truth table for a NOT gate
- Measure input and output waveforms of an NAND gate using a logic probe
- Read the truth table for an NAND gate
- Measure input and output waveforms of a NOR gate using a logic probe
- Read the truth table for a NOR gate
- Measure input and output waveforms of a XOR gate using a logic probe
- Read the truth table for a XOR gate
- Measure input and output waveforms of a half-adder using a logic probe
- Read the truth table for a half-adder gate
- Measure input and output waveforms of a full adder using a logic probe
- Read the truth table for a full adder

Lab Hours: 16

Fundamentals of Problem Solving & Troubleshooting - Electrical
NSCC10083D2

Lab Objectives

The following is a list of objectives for Fundamentals of Problem Solving & Troubleshooting – Electrical:

- Follow a valid and reliable "Troubleshooting Process." The process can then be used to isolate malfunctions in most mechanical, electrical & instrument systems. Five major steps include:
    1. I.D. the Abnormality, Symptom or Fault
    2. Determine the Faulty Element or Component
    3. Plan a Course of Action
    4. Repair the Equipment
    5. Observe & Follow-up on Equipment Operation

- Practice and demonstrate learned skills in troubleshooting the five most common industrial motor control circuits. The 7100 ICST Trainer is used and has approximately 152 different instructor controlled faults.

- Practice and demonstrate learned skills in troubleshooting managing relay circuits on a gas furnace simulator. Includes relays, time delays, limit switches, etc.

Lab Hours: 24

Motor Drives

NSCC100E001

- Use an AC Drive to control an Induction Motor
- Set the operating parameters of an AC Drive
- Protect the motor from overcurrent, overvoltage and overheating

Lab Hours: 32

Managing Electrical Hazards

NSCC10172023

Lab Objectives

- Identify the types and sources of electrical hazards.
- Describe the requirements of NFPA 70E®.
- Identify the causes of electrical incidents and explain how they can be prevented.
- Explain the procedures for analyzing electrical hazards.
- Explain how to establish electrically safe work conditions.
- Identify Grounding Requirements and Applications.
- Size and Select Equipment Grounding.

Lab Hours: 16

Intro to Commercial Electricity

NSCC04042024

Lab Objectives

- Safety for Electricians
- Introduction to Electric Circuits
- Introduction to Distribution Equipment
- Introduction to Transformers
- Introduction to Motor Controls

Lab Hours: 8

OPERATIONS

Chemistry Fundamentals
NSCC1000BD6

Lab Objectives

After completion of this lab, the student will be able to:

- Separate a mixture of liquids by distillation.
- Identify the distillation temperatures of ethyl alcohol (ethanol) vs. water
- Separate two immiscible liquids by decantation and determine the amount of each liquid separated.
- Calibrate a benchtop pH meter.
- Use a benchtop pH meter to measure the pH of solutions.
- Determine the pH of a solution with pH test paper and pH indicator strips.
- Prepare a mixture of alum and distilled water, heat to solution, remove impurities, cool, and recrystallize.
- Filter, dry, and weigh to determine the amount of product recrystallized.
- Extract the soluble solids from a mixture of soluble and insoluble solids.
- Neutralize a weak acid with a weak base.

Lab Hours: 8

Distillation
NSCC1013F89

Lab Objectives

After completion of this lab, the student will be able to:

- Identify and describe column safety
- Identify major components of the glass column at RCAM
- Startup and stabilize the column
- Describe how loss of cooling water affects column operations
- Describe how vacuum affects column operations
- Describe column shutdown procedures
- Startup, stabilize, and troubleshoot a distillation column using a Process Simulator

Lab Hours: 8

Industrial Skills for New Hires
NSCC101E74

Lab Objectives

Upon completion of the Industrial Skills for New Hires training the student will be able to:

- Recognize leaks, odors, moving parts, and hot equipment.
- Demonstrate basic electrical safety including basic bonding and grounding.
- Identify and properly use appropriate PPE for various tasks.
- Determine appropriate ladder to use for the job at hand, its proper use and how to inspect the ladder for damage.
- Explain the importance of protecting the environment, and containment of chemicals.
- Differentiate between interceptor, sanitary, and storm sewers.
- Identify and demonstrate the safe use of hand tools.
- Connect and secure flexible hose.
- Operate a combination lock.
- Secure a trailer using jack stands and wheel chocks.
- Demonstrate workplace cleanup.
- Demonstrate the correct procedure and etiquette for answering and initiating calls using
  - ♦ Handheld radio
  - ♦ Telephone

Use LOTO EXP software to perform a series of virtual Lock Out Tag Out procedures in an immersive 3D environment.

- Use “Lock Out Tag Out Check Sheets” and “Do Not Operate Tags” to identify hard copy documents and their use during the Lock Out Tag Out section of the training.

Lab Hours: 8

Operations Multi-Lab
NSCC04112023

The Operations Multi-Lab combines the following lab objectives: ***Instrumentation & Control, *Operations Digital Instrumentation Overview, *and Distillation.**

Lab Objectives

- Identify the symbols and the typical diagram abbreviations associated with P&ID diagrams. After completion of this lab, the student will be able to:
- Identify and state the function of devices that measure, control, and monitor process variables of pressure, temperature, level, and flow.
- Describe the function and operation of valve actuators, valve positioners, and self-actuating valves.
- Operate and control the simulator: switch simulator controller between manual and automatic, adjust the simulator controller output, and change the set point.
- Operate and troubleshoot a Distributive Control System (DCS).
- Use DeltaV Mimic Simulation Software to simulate operating conditions.

- Designed for the chemical operator, this lab will demonstrate how maintenance personnel correctly configure and calibrate a Rosemount 3051S Series Smart Transmitter and other instruments to the manufacturer's specifications (HART Protocol).
- Identify major components of the glass column at RCAM
- Startup and stabilize the column
- Describe how the loss of cooling water affects column operations
- Describe how vacuum affects column operations
- Describe column shutdown procedures

Lab Hours: 24

Instrumentation and Control
NSCC1000BCF

Lab Objectives

- After completion of this lab, the student will be able to:
- Identify and state the function of devices that measure, control, and monitor process variables of pressure, temperature, level, and flow.
- Describe the function and operation of valve actuators, valve positioners, and self-actuating valves.
- Identify the symbols and the typical diagram abbreviations associated with P&ID diagrams.
- Operate and control the simulator: switch simulator controller between manual and automatic, adjust the simulator controller output, and change the set point.
- Operate and troubleshoot a Distributive Control System (DCS).
- Use DeltaV Mimic Simulation Software to simulate operating conditions.
- Identify the process flow of the Process Trainer.
- Access the filed and view Process Trainer equipment; pumps, piping, valves, and instruments, including three different types of level transmitters.
- Locate instruments on P & I diagram.
- Startup and shutdown Process Trainer using procedures.
- Correct upset conditions.
- Control feed flow to the column using a manual bypass valve.
- Troubleshoot and correct problems in the field.

Lab Hours: 12

Introduction to Chemical Manufacturing
NSCC10262021

Lab Objectives

After completion of this lab, the student will be able to:

- Describe the different types of equipment and valves used in manufacturing processes
- Demonstrate knowledge of basic control room functions
  - ♦ P&ID Review
  - ♦ Field Valve Operation
- ESD & DCS Controls
- Describe appropriate uses of basic hand tools.
- Describe hand and power tool safety.
- Describe the appropriate uses of sparking and non-sparking tools.
- An introduction to the fundamentals of equipment used in oxy-fuel and arc welding, including welding and cutting safety, basic oxy-fuel welding and cutting, basic arc welding processes and basic metallurgy.

Lab Hours: 16

Refrigeration
NSCC10262021

Lab Objectives

After completion of this lab, the student will be able to;

- Start-up and operate the Capillary Tube System on a refrigeration simulator
- Start-up and operate the Automatic Expansion Valve System on a refrigeration simulator
- Start-up and operate the Thermostatic Expansion Valve System on a refrigeration simulator

Lab Hours: 4

Valves, Piping, and Pumps
NSCC1000BBE

Lab Objectives

After completion of this lab, the student will be able to;

- Identify Valves, Pumps, Piping, Relief Devices, Steam Traps, Strainers, Filters, and Screens.
- Describe the various types of piping and piping auxiliaries and their application for material flow.
- Identify the basic types of manually operated valves and operator responsibilities for valve alignment.
- Demonstrate proper body placement when operating a manual valve.
- State how to drain and fill a fluid system and do operator checks.
- Operate a fluid handling skid to simulate pumping chemicals through an operating system.
- Identify and describe the purpose of three commonly used couplings.
- Identify and describe the purpose of major centrifugal pump parts.
- List safety checks that apply to pumping systems.
- Identify the components of a simple pumping system.
- Determine the correct rotation of a centrifugal pump.
- Start up, shut down, and switch centrifugal pumps.
- Identify the major parts of a diaphragm pump and a gear pump.
- Start up and shut down a gear pump.
- Connect hoses and transfer liquid using a diaphragm pump.

Lab Hours: 8

AUTOMATION

Adjustable Frequency Drive-NTAC-003
NSCC07252022

Lab Objectives

After completion of this lab, the student will be able to:

- Define what an adjustable frequency drive is and how it is used.
- Review how the adjustable frequency drive and the adjustable frequency drive controller are connected.
- Review configuration parameters in the adjustable frequency drive controller and setup to make the adjustable frequency drive operate correctly.
- Demonstrate how to operate the adjustable frequency drive manually from the adjustable frequency drive controller.
- Demonstrate how to interface the adjustable frequency drive controller to a process control system and operate the adjustable frequency drive automatically.
- Review faults that may occur causing the adjustable frequency drive to be inoperable.
- Review troubleshooting methods used to detect and fix an adjustable frequency drive fault.

Lab Hours: 16

Introduction to Sensors-MTAC-001
NSCC10272021

Lab Objectives

This lab includes instruction in various sensors and switches.

- Introduction to sensors
- Background suppression photoelectric switch
- Polarized retroreflective photoelectric switch
- Capacitive proximity switch
- Inductive proximity switch
- Limit switch
- Motor-operated circuits using sensors
- PLC-controlled circuits using sensors

Lab Hours: 24

Pneumatic Systems-MTAC-002
NSCC04062022

Lab Objectives

After completion of this lab, the student will be able to understand:

- Basic electrically controlled pneumatic circuits
- Basic and /or logic function circuits
- Basic memory and priority electro-pneumatic circuits
- Sequencing pneumatic applications
- Pneumatic actuator deceleration circuits
- Counting of actuator cycles

Lab Hours: 24

Robotics Fundamentals-MTAC-006
NSCC10032022

Lab Objectives

After completion of this lab, the student will be able to:

- Understand industrial robot history
- Know basic robotics definitions and terminology
- Learn robotics SAFETY.
- Recognize robot components and know robot classifications.
- Learn functions of Teach Pendants and their keys.
- Learn how to set-up a robot.
- Diagnose common issues and learn error recovery
- Develop an understanding of robotics Frames / User Coordinate system.
- Learn to identify programming components.
- Be able to write basic programs and execute them.

Lab Hours: 32

Servo Motors Lab-MTAC-004
NSCC09212021

Lab Objectives

After completion of this lab, the student will be able to:

- Define what a servo motor is and how it is used.
- Review how the servo motor and servo motor controller are connected.
- Review configuration parameters in the servo motor controller and setup to make the servo motor operate correctly.
- Demonstrate how to operate the servo motor manually from the servo motor controller.
- Demonstrate how to interface the servo motor controller to a process control system and operate the motor automatically.
- Review faults that may occur causing the servo motor to be inoperable.
- Review troubleshooting methods used to detect and fix a servo motor fault.

Lab Hours: 16

Vision Sensors Systems-MTAC-005
NSCC08022021

Lab Objectives

After completion of this lab, the student will be able to:

- Define what a vision system is and how it is used.
- Review how the vision system and vision system controller are connected.
- Review configuration parameters in the vision system controller and setup to make the vision operate correctly.
- Demonstrate how to operate the vision system manually from the vision system controller.
- Demonstrate how to interface the vision system controller to a process control system and operate the vision system automatically.
- Review faults that may occur causing the vision system to be inoperable.
- Review troubleshooting methods used to detect and fix a vision system fault.

Lab Hours: 8

MACHINING

Basic Math
NSCC0022024

Lab Objectives

- Get familiar with math skills and concepts needed for shop activities
- Solve problems with fractions
- Solve problems with decimals
- Angle Calculations

Lab Hours: 42

Prerequisites: None

Safety
NSCC0012024

Lab Objectives

- Understand the cost of accidents and how they affect productivity and competitiveness in the industry.
- Explain and apply OSHA's mission, purpose, and coverage and be knowledgeable of an employee's rights and responsibilities.
- Understand mechanical hazards.
- Identify methods of machine safeguarding
- Be able to apply a lockout-tag-out system.
- Understand MSDS-SDS, and hazard communication standards
- Understand blood born pathogen safety
- Understand safe lifting practices and first aid

Lab Hours: 45

Prerequisites: None

Precision Measuring Instruments-: NC3, Snap-On, Starrett Certificate NSCC05122021

Lab Objectives

- Understand basic safety guidelines as related to the use of precision measuring tools.
- Properly maintain precision measuring tools.
- Describe the basic design of various tapes, rules and calipers to include feature, sizes, variations and technology behind the tool.
- Know and understand the difference between field check and calibration and how to preform both.
- Demonstrate the application and use of tapes, rules and calipers including reading and obtaining accurate measurements.
- Demonstrate the application and use of dial calipers including reading and obtaining accurate measurements.
- Demonstrate the application and use of depth gages, screw pitch gages, and thickness gages.
- Demonstrate the application and use of protractors and combination square sets
- Demonstrate the application and use of micrometers small hole gages and telescoping gages including reading and obtaining accurate measurements.
- Demonstrate the application and use of dial gages and bore gages including reading and obtaining accurate measurements.

Lab Hours: 16

Prerequisites: None

Conventional Machine Tool 1: Intro to Machine Tools NSCC1012021

Lab Objectives

- Employ proper layout tools, hand tools, and inspection equipment.
- Solve machine shop-related problems using appropriate mathematical methods.
- Apply knowledge of safety as related to operating machine tools.
- Apply knowledge of the engine lathe and its operation in truing, facing, and thread chasing.
- Set up and operate the vertical milling machine.
- Align a mill vise and align the head on the vertical milling machine.

Lab Hours: 86

Prerequisites: *NSCC05122021 Precision Measuring Instruments*

Conventional Machine Tool 2: Intermediate Machining Processes
NSCC1022021

Lab Objectives

- Solve machine shop-related problems using appropriate mathematical methods.
- Select proper cutters, speeds, and feeds for the milling machine, lathe, and shaper.
- Select proper work-holding devices.
- Select the proper cutting tool holders.
- Set the machine to cut internal threads, tapers, and boring specifications.
- Choose the proper drill size for tap drilling.
- Select the proper speeds and feeds for drilling, reaming, and counterboring.
- Resharpen and repoint a twist by hand grinding using the pedestal grinder.
- Set up all common operations on engine lathes, milling machines, and drill presses.

Lab Hours: 106
Prerequisites: NSCC1012021 Conventional Machine Tool 1

Conventional Machine Tool 3: Advanced Machining Processes
NSCC2012021

Lab Objectives

- Accurately locate and produce precision holes.
- Properly heat treat and temper steel.
- Use the surface grinder with accuracy.
- Select proper grinding wheel for the job.
- Plan the sequence of operation for fabrication of a machined part while working from a blue print or sketch.
- Calculate hole locations using the coordinate system.

Lab Hours: 64
Prerequisites: *NSCC1022021 Conventional Machine Tool 2*

Basic Blueprint Reading
NSCC1032021

Lab Objectives

- Be acquainted with terminology commonly used in the machine trades area to effectively interpret blueprints.
- Learn to read and interpret blueprint drawings
- Identify dimensioning systems.
- Identify the different kind and uses of lines in blueprint reading.
- Learn dimensioning techniques
- Learn tolerancing
- Learn how to convert fractions to decimals

- Learn how to convert fractions to decimals
- Learn how to draft lines using geometric equations
- Learn about different line types
- Learn about orthographic views
- Learn about offset sections, auxiliary sections, symbols and broken sections.

Lab Hours: 38
Prerequisites: None

Applied Mathematics
NSCC1042024

Lab Objectives
- Solve problems with fractions.
- Solve problems with decimals.
- Understand units of measurement in the English System
- Understand units of measurement in the Metric System
- Convert length measurements with int English System
- Convert length measurements with int English System
- Convert between English and Metric Systems
- Solve for unknown variables in mathematical equations.
- Solve and graph various types of linear equations.
- Work with rate conversions in algebraic terms
- Calculate slope.
- Simplify and solve problems with exponents and radicals.

Lab Hours: 42
Prerequisites: *None*

Intro to CNC Machine Operations
NSCC2022022

Lab Objectives
- Create CNC programs for machining centers using standard G-codes.
- Create CNC programs for turning centers using standard G-codes
- Calculate appropriate speed and feed parameters based on cutter and material requirements.
- Identify CNC application and requirements to perform required task.
- Determine the most practical sequence of operations for machining a part.
- Determine and enter appropriate work, tool, and cutter compensation offsets
- Safely run a first part and inspect for errors
- Troubleshoot program issues and make necessary corrections.

Lab Hours: 64
Prerequisites: NSCC2012021 Conventional Machine Tool 3, NSCC2032024 Intermediate Blue Print Reading, NSCC1052024 Applied Mathematics

Intermediate Blueprint Reading
NSCC2032024

Lab Objectives

- To increase your efficiencies in blueprint reading
- Understand the relationship between blueprints and how they apply to manufacturing parts
- Understand different line types, views, dimensioning and machining processes
- Learn fraction to decimal conversion
- Understand line types and symbols
- Understand how to draft lines using geometric equations
- Understand orthographic views, and isometric views
- Understand offset sections, auxiliary sections and broken sections

Lab Hours: 38

Prerequisites: *NSCC1032021 Basic Blueprint Reading*

Intermediate Applied Math
NSCC2042024

Lab Objectives

- Increase efficiencies in shop related math skills
- Learn to properly use Pythagorean Theory
- Learn to properly use trigonometric functions and their applications
- Learn to apply trigonometry to the use of sine bars, gage blocks for use in setting up angles to be machined.

Lab Hours: 42

Prerequisites: *NSCC1052024 Applied Mathematics*

Intermediate Blueprint Reading with Basic Essentials for GD&T
NSCC2052024

Lab Objectives

- Understand GD&T symbols
- Understand feature control frames and the information within them
- Understand datums and how they apply to GD&T

Lab Hours: 38

Prerequisites: NSCC2042021 Intermediate Blue Print Reading, and NSCC2042024 Intermediate Applied Math

Advanced Measuring Instruments: NC3, Snap-On, Starrett Certificate
NSCC05182021

Lab Objectives

- Understand and demonstrate proper use of primary standards
- Understand and demonstrate proper use of flexible measuring instruments.
- Understand and demonstrate proper support and layout procedures.
- Understand and demonstrate proper use of optical comparators.
- Understand and demonstrate proper use of surface finish and hardness inspection processes.
- Demonstrate and understands data acquisition and its application.

Lab Hours: 70

Prerequisites: *NSCC05122021 Precision Measuring Instruments*

Intro to CNC Programming
NSCC3012022

Lab Objectives

- Create CNC programs for machining centers using standard G-codes.
- Create CNC programs for turning centers using standard G-codes.
- Calculate appropriate speed and feed parameters based on cutter and material requirements.
- Identify CNC applications and requirements to perform the required task.
- Determine the most practical sequence of operations for machining a part.

Lab Hours: 102

Prerequisites: *NSCC2022022 Intro to CNC Machine Operations, NSCC2052024 Intermediate Blue Print Reading with Basic Essentials for GD&T*

Lab hours: 64

Prerequisites: *NSCC3012022 Intro to CNC Programming*

Intro to CAD/CAM
NSCC3032023

Lab Objectives

- Create part geometry using CAD/CAM software.
- Generate CNC programs for machining centers using CAD/CAM software.
- Transfer CAD part files between software applications.
- Post process and download CNC programs to machining centers.
- Determine the most practical sequence of operations for machining a part.
- Determine the tooling and fixture requirements necessary for machining a part.
- Use mathematical formulas to calculate proper cutting parameters.
- Estimate the sequence of operations and time required to program and machine apart.

Lab hours: 64

Prerequisites: *NSCC3012022 Intro to CNC Programming*

Metallurgy
NSCC3042024

Lab Objectives

- Define the physical and mechanical properties of metals, plastics, ceramics, and composites.
- Describe the atomic structure of materials.
- Describe how properties relate to manufacturing applications.
- Understand electrical, magnetic, and thermal properties.
- Understand thermal expansion and thermal stress.
- Understand corrosion and thermal degradation.
- Understand stress and strain.
- Understand elastic and plastic deformation.
- Understand tensile, compressive, and shear stresses.
- Understand ductility, toughness, and hardness and how these qualities are tested.
- Understand the types of metal crystal structures and their properties.
- Understand the connection between grain structure and mechanical properties.
- Distinguish between pure metals and alloy metals.
- Distinguish between ferrous and nonferrous metals.
- Understand the properties of superalloys.
- Understand steel classification and grades.
- Understand heat treating, annealing, normalizing, tempering, and quenching and their effect on metal.
- Understand different quenching mediums.
- Understand hardness testing and the different hardness scales.

Lab Hours: 38

Prerequisites: *None*

Geometric Dimensioning and Tolerancing
NSCC3052024

Lab Objectives

- Interpret dimensions and tolerances as pertaining to machine drawings.
- Be familiar with chain dimensioning vs. datum dimensioning, tabulated dimensioning.
- Identify how tolerance is determined
- Be familiar with GD&T terminology
- Understand the influence that tolerances have on cost
- Distinguish between traditional tolerancing and GD&T
- Understand the advantages of GD&T
- Understand bonus tolerances
- Understand feature control frames and how they locate the part in the datum reference plane

Lab Hours: 38

Prerequisites: *NSCC2052024 Intermediate Blue Print Reading w Basic Essentials for GD&T*

Advanced Math 1
NSCC3062024

Lab Objectives:

- Understand more complex applications of geometry
- Understand more complex applications of trigonometry and the law of sines and cosines

Lab Hours: 38

Prerequisites*: NSCC2052024 Intermediate Applied Math*

Advanced CNC Operations 1: 5-Axis and Live Tooling
NSCC4012024

Lab Objectives

- Set up a trunnion in a mill
- Find the center of rotation on a trunnion
- Set up and use Tool Center Point Control (TCPC) in a Haas mill
- Set up and run parts on a trunnion in a mill
- Set up live tools in a lathe
- Locate live tools in a lathe
- Set up and run parts in a lathe with live tooling

Lab Hours: 24

Prerequisites: *NSCC3062024 Advanced Math 1*

Advanced CNC Programming 1: 5 Axis Programming
NSCC4022024

Lab Objectives

- Understand the proper use of sub programs for repetitive processes
- Understand the calculations involved in sub programming
- Use CAD to draw parts for 5 axis mills
- Use CAM to program a 5 axis mill
- Load program into the machine
- Perform a first part run and inspection
- Trouble shoot programs

Lab Hours: 24

Prerequisites *NSCC4012024 Advanced CNC Operations 1: 5-Axis and Live Tooling*

Advanced CNC Programming 2: Live Tooling
NSCC4032024

Lab Objectives:

- Operate and program a mill turn lathe
- Use CAD to create drawings for programming live tooling
- Use CAM to program live tooling
- Load programs into the machine
- Perform a first part run and inspection
- Trouble shoot programs

Lab Hours: 32

Prerequisites *NSCC4012024 Advanced CNC Operations 1: 5-Axis and Live Tooling*

Welding Basics
NSCC4042023

Lab Objectives

- Display an understanding of safe work practices and the hazards of welding
- Understand the different types of welding
- Know the different joint types
- Understand how to prepare a joint
- Show competency in welding two pieces of metal together
-

Lab Hours: 8

Prerequisites: *None*

Advanced CNC Operation 2: Jigs and Fixtures
NSCC4062024

Lab Objectives

- Use basic jig and fixture design theory.
- Employ basic precision machining skills.
- Identify the components of a drill jig.
- Do a layout to scale a jig or fixture.
- Understand the principles of holding and positioning of parts in a jig or fixture.
- Determine the best method for manufacturing a part.
- Present ideas to a team in a professional manner.
- Work as a team to complete a common goal.
-

Lab Hours: 70

Prerequisites: *NSCC4042024 Advanced Programming 3: Waterjet, NSCC4012024 Advanced CNC Programming 2: Live Tooling*

Advanced CNC Programming 3: Live Tooling and Water jet Programming
NSCC4052024

Lab Objectives

- Display an understanding of safe work practices for waterjets.
- Display an understanding of the software used to program waterjets.
- Display an understanding of how to safely set up a waterjet machine.
- Display an understanding how different materials and material thickness affects the outcome of a part.
- Perform a first part run and inspection
- Trouble shoot programs and drawings

Lab Hours: 32

Prerequisites: *None*

Advanced Applied Math
NSCC4082024

Lab Objectives

- Understand, on a greater level, how to solve for unknown surfaces found on advanced blueprints

Lab Hours: 38

Prerequisites: *NSCC4082024 Advanced Math 1*

Advanced Math 2
NSCC4092024

Lab Objectives

- Further understand how to solve for unknown surfaces found on advanced blueprints

Lab Hours: 38

Prerequisites: *NSCC4082024 Advanced Applied Math*

Manufacturing Technology
NSCC4072024

Lab Objectives

- Familiar with the wide range of manufacturing processes.
- Identify different casting operations.
- Identify traditional and non-traditional metal-removal processes.
- Able to process a part through the machining process from a blue print.
- Familiar with manufacturing specifications.
- Identify the materials testing processes.
- Identify the joining processes.
- Familiar with heat treatment of metals.

Lab hours: 38

Prerequisites: *NSCC1022021 Conventional Machine Tool 2*

CERTIFICATIONS

Certified Production Technician (CPT) 4.0

The Manufacturing Skill Standards Council (MSSC) credentialing system leading to a CPT 4.0 covers the four critical production functions, as defined by MSSC's industry-led, nationally validated skills standards, common to all sectors of manufacturing: Safety, Quality Practices & Measurement, Manufacturing Processes & Production, and Maintenance Awareness. Each area is addressed with a separate assessment. MSSC training and assessments are organized around those four modules. An individual can earn a "Certificate" if they pass one or more assessments. However, they must pass all four assessments to earn the full "CPT 4.0" certification.

Lab Objectives

SAFETY MODULE

1. Work in a Safe and Productive Manufacturing Workplace
2. Perform safety and environmental inspections
3. Perform emergency drills and participate in emergency teams
4. Identify unsafe conditions and take corrective action
5. Participate in safety training
6. Participate in equipment safety training
7. Suggest processes and procedures that support the safety of the work environment
8. Fulfill safety and health requirements for maintenance, installation, and repair
9. Monitor safe equipment and operator performance
10. Utilize effective, safety-enhancing workplace practices

QUALITY PRACTICES & MEASUREMENT MODULE

1. Participate in periodic or statistically-based internal quality audit activities
2. Check and document calibration of gauges and other data collection equipment
3. Suggest continuous improvements
4. Inspect materials and product/process at all stages to ensure they meet specifications
5. Document the results of quality tests
6. Communicate quality problems
7. Take corrective actions to restore or maintain quality
8. Record process outcomes and trends
9. Identify fundamentals of blueprint reading
10. Use common measurement systems and precision measurement tools

MANUFACTURING PROCESSES & PRODUCTION MODULE

1. Identify customer needs
2. Production equipment operation
3. Determine resources available for the production process
4. Set up and verify equipment for the production process
5. Set team production goals
6. Make job assignments
7. Coordinate workflow with team members and other work groups
8. Communicate production and material requirements and product specifications
9. Perform, and monitor the process to make the product
10. Document product and process compliance with customer requirements
11. Prepare the final product for shipping or distribution

MAINTENANCE AWARENESS MODULE

1. Perform preventive maintenance and routine repair.
2. Monitor indicators to ensure correct operations.
3. Perform all housekeeping to maintain the production schedule.
4. Recognize potential maintenance issues with basic production systems, including knowledge of when to inform maintenance personnel about problems with:

- Electrical systems
- Pneumatic systems Hydraulic systems
- Machine automation systems
- Lubrication processes
- Bearings and couplings
- Belts and chain drives

Lab Hours: 84

Certified Logistics Technician (CLT) 4.0

The Manufacturing Skill Standards Council (MSSC) credentialing system leading to a CLT covers core competency areas, as defined by MSSC's industry-led, nationally validated skills standards for higher skilled, frontline material handling workers across all supply chain facilities: factories, warehouses, distribution centers, and transporters. Individuals are assessed for two credentials: the foundational-level Certified Logistics Associate (CLA) certificate and mid-level Certified Logistics Technician (CLT) Certification.

CLA is a prerequisite for CLT.

Lab Objectives

CERTIFIED LOGISTICS ASSOCIATE (CLA)

1. Global supply chain logistics life cycle
2. Logistics environment
3. Material handling equipment
4. Safety principles
5. Safe material handling and equipment operation
6. Quality control principles
7. Workplace communications
8. Teamwork and workplace behavior to solve problems
9. Using computers

Lab Hours: 40

CERTIFIED LOGISTICS TECHNICIAN (CLT)

1. Product receiving
2. Product storage
3. Order processing
4. Packaging and shipment
5. Inventory control
6. Safe handling of hazmat materials
7. Evaluation of transportation modes
8. Dispatch and tracking
9. Measurements and metric conversions

Lab Hours: 40

Regional Center for Advanced Manufacturing

NCCER PROJECT MANAGEMENT CERTIFICATE

NCCER's curriculum in Project Management helps learners develop an understanding of construction materials and methods, mathematics, communications, safety, human resources, scheduling, and customer service. Curriculum topics include Construction Documents, Resource Control, and Continuous Improvement.

- Introduction to Project Management
- Safety
- Interpersonal Skills and Resolutions
- Construction Documents
- Construction Planning
- Estimating and Cost Control
- Scheduling
- Resource Control
- Quality Control and Assurance
- Continuous Improvement

Lab Hours: 116.5

NC3 CERTIFICATION(S)

STEM Certifications | Introduction -NC3 STEM-certified students are introduced to various aspects of technical education with the idea of discovery. The certifications are designed to allow students to explore their interests in technical fields. The student can determine if a career path in a technical field is of interest to them.

Level 1 Certifications | Fundamentals -NC3 certified students in Level 1 are well-rounded machine operators/technicians, with responsibility for the efficient operation of the equipment. They ensure the system is running at maximum capacity with an understanding of the role of each component and device. They can identify malfunctions and make minor repairs.

STEM: Introduction to Mechatronics	Lab Hours: 24
DREMEL 3D Printing	Lab Hours: 24

Level 1: Fundamentals

Fundamentals of Industry 4.0	Lab Hours: 8
Fundamentals of Fluid Power – Pneumatics	Lab Hours: 16
Fundamentals of Fluid Power – Hydraulics	Lab Hours: 16
Fundamentals of Sensor Technology	Lab Hours: 16
Fundamentals of PLC – Siemens	Lab Hours: 24
Fundamentals of Robotics	Lab Hours: 24
Fundamentals of Electricity	Lab Hours: 32

OSHA 10-HOUR PROGRAM CERTIFICATION

Lab Objectives

- Promotes safety culture through peer training.
- Training is intended to be participatory, using hands-on activities.
- Outreach training content includes hazard recognition and avoidance, workers' rights, employer responsibilities, and how to file a complaint; it emphasizes the value of safety and health to workers, including young workers.
- The 10-hour training program is primarily intended for entry-level workers and provides awareness of common job-related safety and health hazards.

Lab Hours: 10

OSHA 30-HOUR PROGRAM CERTIFICATION

Lab Objectives

Promotes safety culture through peer training.
Training is intended to be participatory, using hands-on activities.
Outreach training content includes hazard recognition and avoidance, workers' rights, employer responsibilities, and how to file a complaint; it emphasizes the value of safety and health to workers, including young workers.
The 30-hour training program is intended to provide workers with some safety responsibility a greater depth and variety of training.

Lab Hours: 30

NORTHEAST STATE
We're here to get you there

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