KENT STATE UNIVERSITY | Regional Workforce Development

Multicraft Technician (online)

Program Objectives & Descriptions

INTRODUCTION

REA5-Study Skills

- Construct spoken and numbered outlines
- Summarize a paragraph
- Know the three types of reading: study reading, skimming, and scanning
- Apply study skills to mathematics
- Know a series of steps to solve problems

Maintenance Principles

- Shows workers how solid maintenance principles can be used to reduce the influence of defects that come from 5 sources: Workmanship, Operation, Materials, Design, Failure Events

TRB1 – Maintenance Troubleshooting: Procedures

- Identify the abnormality or symptom based on normal operation behavior
- Determine the faulty element or component based on symptoms
- Plan a course of action to repair the equipment
- Safely perform repairs on the equipment
- Apply observation techniques to prevent reoccurrence once the problem is repaired.

BASIC MATH

MAT1-Whole Numbers

- Learn to recognize and use symbols of arithmetic
- Learn the place value of numbers
- Learn to add, subtract, multiply and divide whole numbers
- Learn to solve arithmetic problems

MAT2-Fractions

- Learn the parts of a fraction
- Learn to determine fractional parts of quantities
- Learn to add & divide fractions
- Learn basic arithmetic functions using fractions and mixed numbers

MAT3-Decimals

- Learn about the use of decimals
- Learn the value of zeros in decimals
- Learn to round off decimals
- Learn to identify repeating decimals
- Learn to add, subtract, multiply, and divide decimals
- Learn to calculate percent's

MAT4-Algebra

- Learn about signed numbers and how they are represented on a number line
- Learn to subtract, multiply, and divide signed numbers
- Learn to use variables in solving equations
- Learn to determine the value of square roots

Learn to use numbers with exponents and powers of 10
Learn to simplify algebraic expressions by removing grouping symbols
Learn to perform operations in their proper sequence
Learn to solve equations that have one unknown

(TPC) BASIC MECHANICS

Covers force and motion, work and energy, and fluid mechanics as applied in industrial maintenance. Explains principles of operation for simple machines, such as the lever, inclined plane, wheel and axle, pulley, and screw. Explains the basic elements of industrial machines, as well as common measurement tools used to monitor and adjust equipment. Covers hand tools, power tools and fasteners, ending with a discussion of ways to reduce friction and wear.

PRINT READING

PRT1-Print Reading: Orthographic Projections

Identify the principle views used in orthographic projections
Identify the types of lines used in projection drawings and the purpose of each
Identify auxiliary and sectional views
Identify the differences between first and third angle projections

PRT2-Print Reading: Format and Dimension

Identify characteristics of standard sheet sizes
Identify features of engineering drawings
Explain how an object's features are defined and located using dimensions
Explain tolerance dimensioning

PRT3-Print Reading: Types and Symbols

Identify the differences between layout, detail, prefix, and assembly drawings
Recognize general identification and revision notes and symbols
Identify special markings, including surface texture, welds, rivets, and datums

PRT4-Thread Specifications

Identify thread features
Describe the most common thread forms and their characteristics
Recognize the differences between English and metric thread notes

(TPC) READING SCHEMATICS & SYMBOLS

Covers all types of schematics and symbols used in commercial and industrial settings. Examines symbols on schematics, electrical symbols and diagrams, piping symbols and diagrams, hydraulic and pneumatic diagrams and symbols. Discusses air conditioning and refrigeration systems, including explanations of electrical/electronic control schematics. Covers welding and joining symbols.

SAFETY & HEALTH

Personal Protective Equipment: Don't Start Work without It

At work, everybody part is vulnerable to injury and you have to make sure that your employees are well-protected. They face unique dangers depending on the job each one does. Accordingly, their PPE must be customized so that they can cope with the risks. Get this comprehensive PPE course, covering eye, face, hearing, head, hand and foot protection, and other PPE rules. Covers:

Personal Protective Equipment
Eye and Face Protection
Hearing Protection
Head Protection
Hand Protection

Foot Protection

Lockout Tagout: Lightening In A Bottle

Lockout/Tagout Basics and Standard

Energy Types and Lockout/Tagout Basics

OSHA's Lockout/Tagout Standard

Six Steps For Lockout/Tagout

Preparation, Shutdown and Isolation

Application, Restraint and Verification

Removal And Re-Energizing

Three Steps of Removal/Re-Energizing

Inspection and Training

Electrical Safety: Beware the Bite

Levels of Protection: Conductivity, Engineering Controls

Safe Work Practices: Safety at Work, Lockout/Tagout, Lockout/Tagout for Energized Systems

Effective Safety Measures: Personal Protective Equipment, Emergency Rescue and First Aid

ArcFlash: Live to Tell

Definition of arc flash

Safety documentation and regulations

Latest information on NFPA 70E

Qualified vs. unqualified persons

Three critical approach boundary areas

Job planning and hazard analysis

Lockout/tagout procedures

Proper PPE application

Machine Guarding: Safeguarding Your Future

Practically every machine has some sort of machine guarding – a shield, automatic shutoff or even a laser curtain – to protect workers if a body part should come in contact with the machine. In fact, OSHA requires specific machines to have specific guards. Make sure your employees understand the importance of knowing about and using the machine guards meant to protect them.

HAzCom: In Sync with GHS

As you know, the chemicals that your employees work with everyday can cause a multitude of physical and health hazards including chemical burns, respiratory problems, and fires and explosions. The Occupational Safety and Health Administration's (OSHA) Hazard Communication standard has recently been enhanced with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). This new HazCom standard not only gives workers the right to know the chemicals and hazards they face, but the right to understand them and how to protect themselves from danger. DuPont Sustainable Solutions' new HazCom: In Sync with GHS will help employees understand this new standardized process of communicating chemical hazards. Covers:

Classes of Hazards

Hazard Classification Labels

Labels on Shipped Containers

Pictograms

Workplace Labeling

Safety Data Sheets

Communicating Chemical Hazards

Communication

Written Program

Information for Workers

(TPC) INDUSTRIAL SAFETY & HEALTH

Explains government involvement in ensuring a safe workplace. Discusses safety in various situations. Discusses personal protective equipment and fire safety. Includes expanded coverage of many health hazards. Covers ergonomics, environmental responsibility and importance of maintaining a safe work environment.

OSHA 10 HOUR GENERAL INDUSTRY

The 10-hour General Industry Outreach Training Program is intended to provide an entry level general industry worker's broad awareness on recognizing and preventing hazards on a general industry site. Students will be introduced to OSHA policies, procedures and standards as well as general industry safety and health principles and work practices covered in OSHA Act Part 1910. Special emphasis will be placed on areas most hazardous using OSHA standards as a guide. General industry workers must receive additional training, when required by OSHA standards, on specific hazards of the job Upon successful completion of the course, participants will receive an OSHA 10-Hour General Industry Outreach DOL course completion card within 4-6 weeks.

LUBRICATION

MLU1-Lube Oil: Types Properties and Handling

Understand the significance of proper lubrication
Identify the types of oils used, their characteristics, and the various ways to apply lubricants
Describe the centralized and portable methods for applying lubricants and various fittings that may be necessary for proper lubrication
Understand the guidelines for proper lubricant storage, both indoors and outdoors

MLU2-Lube Oil: Equipment and Procedures

Describe lubricant applications and standards
Properly dispense machinery oils using lubrication equipment and fittings
Describe the proper procedures for oiling with various lubrication systems

MLU3-Lube Grease: Types Application and Equipment

Describe the key grease properties and functions
Identify grease types
Use manual, powered, and automatic lubricators properly
Understand safe procedures to handle, store, and dispense grease

INS9-Lubrication System Inspection

Identify the types of lubrication oils
Inspect grease packs, pumps, distribution valves, pipes, joints, and bearings
Inspect suction filters, pump units, and pressure and check valves
Inspect lubrication parts

DRIVE COMPONENTS

MDR1-Industrial Drive Systems: Belt Drives

Identify common industrial belt drive systems
Identify the different drive systems and discuss drive ratios
Perform basic installation and maintenance procedures
Troubleshoot

MDR2-Industrial Drive Systems: Chain Drives common belt drive system problems

Perform basic chain drive installation and maintenance procedures
Troubleshoot some common chain drive system problems

INS7-Operator Inspection: Belt Drive, chain drive, & gear box inspection

- Identify and describe the types and functions of belts and gears
- Describe the inspection procedures of belt and chain transmission parts and units
- Explain methods for inspecting gears.

CDP1-Complete Drive Packages

- Identify the components of a directly coupled drive system
- Understand the characteristics of operation unique to directly coupled drive systems
- Identify the components of jackshaft and auxiliary drive systems
- Explain the unique properties of jackshaft and auxiliary drive systems
- Explain the effects of changing input and output speeds on auxiliary and jackshaft drive systems
- Compute drive system efficiency
- Understand the principles of operation for spring operated, shear pin, and heat-actuated overload devices
- Learn troubleshooting strategies for drive packages

EDS1 - Enclosed Drive Systems

- Understand the principles of operation and terminology used in enclosed drive systems
- Identify the components used in an enclosed gear drive
- Identify different gear types
- Understand applications for enclosed gear drives
- Identify the various types of adjustable speed enclosed drives
- Understand applications of an enclosed chain drive system
- Identify and describe the component parts and operation of an enclosed chain drive
- Install an enclosed drive
- Explain proper maintenance procedures
- Describe proper procedures when troubleshooting an enclosed drive system

CBR1-Clutches & Brakes: Types, Principles, and Functions

- Describe the different types of mechanical clutches and brakes, their components, and operation
- Describe applications and troubleshooting procedures for mechanical clutches and brakes
- Describe pneumatic and hydraulic clutches and brakes, their components, and operation
- Describe pneumatic and hydraulic control systems
- Describe applications and troubleshooting procedures for pneumatic and hydraulic clutches and brakes
- Explain the purpose and operation of electrically controlled clutches and brakes
- Identify an electric control system

CBR2-Clutches & Brakes: Troubleshooting

- Troubleshoot several problems in mechanical clutch and brake systems
- Troubleshoot several problems in pneumatic and hydraulic clutch and brake systems
- Troubleshoot several problems in electric clutch and brake systems

INS8-Operator Inspection: Clutch & Brake Inspection

- Identify and describe the types and functions of clutches and brakes
- Identify and describe the types and functions of cams and guide surfaces
- Describe the inspection procedures of clutches and brakes
- Describe the inspection procedures of cams and guide surfaces.

GGS1 - Gear and Gear Systems

- Understand parallel and perpendicular shaft configurations
- Identify and describe the attributes of gears
- Understand gear considerations, Calculate critical dimensions of gears
- Explain installation procedures specific to spur, helical, bevel, miter, and worm gearing
- Describe the types of wear associated with open gearing systems

Explain the inspection procedures for spur, helical, bevel, miter, and worm gear sets
Identify common symptoms and how to determine causes of failure
Explain solutions for open gear systems. Understand safety procedures with open gear systems

SJC1-Shaft Joining and Coupling Devices

Identify different types of shaft joining and coupling devices
Understand the operating principles governing shaft joining and coupling devices
Identify critical application considerations when selecting a connecting device
Differentiate between rigid, flexible, fluid couplings, and universal joints based upon construction, purpose, and application
Understand the safety precautions to follow when performing inspection, maintenance, and repairs
Install and align mechanical couplings
Maintain mechanical couplings
Install, mount, align, test, and maintain a fluid coupling
Recognize symptoms of and troubleshoot fluid couplings and Coupling Devices

BEARINGS

BRG1-Ind. Bearings: Application and Technology

Understand the definition of a bearing
Understand the different types of bearings, including plain, ball, cylindrical, spherical, tapered, and needle
Understand bearing wear and life expectancy
Understand protective housings for bearings
Explain the different types of loads

BRG2-Ind. Bearings: Maint. and Installation

Learn the proper way to install and care for both plain and rolling-element bearings
Identify the different types of fittings for installation
Check proper operating clearances
Understand the importance of proper bearing alignment

BRG3-Ind. Bearings: Troubleshooting

Understand the various ways to identify potential problems and their sources
Understand how to maintain a schedule of monitoring on four major areas of identification
Explain the proper procedures for removing failed bearings
Determine the reasons for failed bearings

PIPING SYSTEMS

(TPC) Piping Systems

Examines piping system materials and sizing. Includes coverage of codes, valves and fittings, and the cutting and joining of piping and tubing. Explains the function and unique requirements of the discharge line, liquid line, and suction line. Concludes with a lesson on piping system maintenance, including handling dirt and scale, expansion, vibration, corrosion, and leaks

VALVES

FVB1-Shutoff Valve Designs and Application Considerations

Explain the general characteristics, construction options, and application considerations of various shutoff valves
Identify the features and limitations of the various valve types
Evaluate shutoff valve performance

FVB2-Selecting Shutoff Valves and Accessories

Understand the major considerations for selecting a shutoff valve type

Identify pressure and temperature requirements
Identify the unique valve requirements imposed by the nature of the controlled fluid
Identify the features, limitations, and suitability of different valve styles
Select an appropriate valve
Select an appropriate means of operating the valve (handwheel, gear drive, power actuator, etc.)

FVB3-Installing Shutoff Valves

Explain good piping practices, including proper valve location and orientation in the pipeline
Understand the importance of pipeline and valve supports
Prevent line hammering
Explain installation considerations for specific types of shutoff valves, including plug, ball, butterfly, globe, gate, and check valves
Properly install valves with screwed, flanged, and welded-end connections
Describe actuator mounting and adjustment

FVB4-Maintaining Shutoff Valves

Identify components and their functions for various valve types
Explain routine preventive maintenance procedures for each valve type
Explain common procedures involved in complete valve repair

CVA1-Basics and Function

Identify the characteristics, function, and application of the control valve
Describe the factors that must be considered when selecting the proper control valve
Describe the functions of a valve actuator and a control valve positioner and how these work within a control system

CVA2-Types & Design

Describe the functions, applications, and differences of linear motion control valves and rotary motion control valves
Describe the functions, applications, and differences of pneumatically operated actuators, electrically operated actuators, and rotary motion actuators
Describe the basic operation and function of the components of the control valve
Identify factors that affect control valve safety

CVA3-Fundamentals and Selection

Describe the different types of fluid flow
Identify the factors that affect fluid flow
Explain the formulas used for determining valve selection
Describe the conditions of fluid flowing through a restriction such as a Herschel venture, a concentric orifice, and Vena Contracta
Explain cavitation, flashing, and fluid flow
Explain the considerations for selecting a control valve
Describe the preliminary criteria for selecting the proper actuator and auxiliary devices

CVA4-Sizing and Installation

Describe the factors to consider for correctly sizing a valve
Recognize what items are needed to determine proper valve sizing
Determine the proper control valve to be used for a liquid, gas, and vapor application
Describe the factors involved with actuator sizing, such as static force, valve leakage classification, and dynamic forces
Recognize the proper installation and maintenance procedures of a control valve

PNEUMATICS

PNM1-The Power of Compressed Air

Power transmission systems are found in equipment ranging from simple devices to complex industrial machines. This course introduces pneumatics — the transfer, control, and use of energy contained in compressed and flowing air. It provides a basic description of the characteristics of matter and describes the relationship between pneumatic properties. In addition, it describes the factors that affect air flow and velocity as well as the effects that temperature, water vapor, air saturation, and condensation have on a pneumatic system. The course covers: The characteristics of matter, Molecular level, Air, Properties of pneumatics, Specific volume, pressure, and temperature; Air flow, Factors affecting air flow, Air saturation, Condensation.

PNM2-The Pneumatic Circuit

A pneumatic circuit is a combination of components that work together to produce, control, and transmit energy. This course introduces several of these energy-transferring and air control components and the symbols used to represent them. The course covers:

Energy transferring components, Compressors, Valves, Actuators
Air control components. Directional control valves, Flow control valves
Regulators, Tanks and filters
Pneumatic symbols, Communicating with pictures
Pumps, filters, and lubricators

PNM3-Processing Air

This course introduces components that process air by compressing, storing, treating, and distributing air to the actuator. Although sometimes overlooked, these components have a major impact on system operation. The course covers:

Compressors, Single-stage, Multi-stage and dynamic
Pressure and flow rate capacities, Sustaining compression
Air storage, Tank accessories, Air sustaining components
Branch and loop systems.

PNM4-Using Compressed Air

Linkages can produce complex motion patterns, the origin of the motion is always one of these two types. This course focuses on the pneumatic components that produce motion. The course covers:

Linear actuators, cylinders, cylinder accessories
Theory of operation
Seals, Nonlinear actuators, Rotary actuators
Air motors, Torque, Nozzles and orifices.

PNM5-Pneumatic Control Valves

To be effective, actuators must move loads in the proper sequence, at the correct time, and at the desired speed. In pneumatic systems, this type of control is accomplished through the use of valves that control the direction of air flow, regulate actuator speed, and respond to changes in air pressure. This course focuses on pneumatic control valves. The course covers:

Directional control valves, One- and two-way valves, Three- and four-way valves
Methods of actuation, Flow control valves
Exhaust valves and air fuses
Simple and specialized regulators
Valve performance, Selecting valves.

PNM6-Working Safely with Pneumatic Systems

This course describes the safety hazards associated with pneumatic systems. It also covers the safety rules that should be followed when working with individual pneumatic components. The course covers:

Pneumatic system safety, Common hazards and remedies

Working with air tools, Oil and water
Safe installation and operation
Compressors, tanks, and actuators
Control valves
Air treatment devices

PNM7-Pneumatic System Maintenance

This course explains the importance of a pro-active maintenance program for pneumatic systems. It describes the major categories of tasks that should be part of a preventative maintenance program and identifies some specific tasks that should be performed during routine maintenance. The course covers:

Pro-active maintenance, Types of maintenance systems
Inspection, Valves and conductors, Checking alignment
System cleanliness, Servicing, Preparing for servicing
Air treatment components, Final maintenance tasks, Testing
Reconditioning and scheduling.

PNM8-System Troubleshooting

This course explores the concept of troubleshooting and covers one systematic approach to identifying problems and determining their causes. The course also examines the various root causes of bearing failure, including over-lubrication, contamination, and misalignment. The course covers:

The four indicators for determining bearing condition
Temperature, Noise and vibration, Seals, Lubrication
Removing and inspecting failed bearings
Causes of premature failure
Pitting and spalling, Electrostatic pitting, True brinelling
Fretting corrosion, Heat damage, Frictional bearing wear
Rust or corrosion, Equipment adjustment

INS1-Pneumatic System Inspection

Understand the basic characteristics of air, including pressure, flow, and volume
Explain how external conditions can affect air
Identify the operating principles of pneumatic systems, including Pascal's Law
Identify the components and function of the air compression system
Understand the general safety procedures for operating a pneumatic system
Differentiate between suction pressure and discharge pressure
Describe the three-step process for establishing the general inspection components and inspection points of the pneumatic system

HYDRAULICS

IDH1- Basic Principles and Application

Understand the basic principles and components of hydraulic power systems
Explain proper storage, handling, and maintenance procedures

IDH2-Types and Concepts

Identify and explain hydraulic piping, fitting, and connections
Understand hydraulic pumps
Identify and explain hydraulic system and pump mechanisms
Understand pressure control valves

IDH3-Function and Operating Principles

Identify the types and functions of directional control valves and accumulators
Identify the types of hydraulic cylinders
Understand operating principles and applications of hydraulic motors
Identify types, operating principles, and common uses of rotary actuators

Explain maintenance and troubleshooting practices that apply to the entire hydraulic system

IDH4-Maintenance and Troubleshooting

Perform reservoir, heat exchanger, and pump maintenance
Understand maintenance safety
Explain troubleshooting procedures for hydraulic systems

HDL1-Harnessing Hydraulic Power

Identify the conditions that cause fluids to flow and exert pressure
Explain Pascal's law
Describe the relationship between fluid pressure and fluid flow
Identify factors that affect pressure level, flow rate, and fluid velocity in a hydraulic circuit

HDL2-The Hydraulic Circuit

Identify the components of a typical hydraulic circuit
Describe the function of components found in a basic hydraulic circuit
Explain the structure and operation of basic hydraulic components
Identify graphic symbols used to represent basic hydraulic components

HDL3-The Hydraulic Pumps & Actuators

Describe the basic structure and operation of balanced and unbalanced vane pumps, internal and external gear pumps, and radial and axial piston pumps
Identify methods of varying the displacement in vane pumps and radial and axial piston pumps
Describe the basic structure and operation of various types of motors and rotary actuators
Describe the basic structure and operation of various types of cylinder devices such as rod gland bushings and seals, piston seals, air bleed passages, stroke adjusters, stop tubes, and cushions

HDL4-Hydraulics: Control Valves

Describe the basic structure and operation of normally closed and normally open pressure control valves
Describe the uses for relieve, unloading, sequence, counterbalance, brake, pressure-reducing valves, and flow control valves
Explain how pressure compensation enables a flow control valve to maintain a desired flow rate regardless of pressure fluctuations
Describe the function and basic operation of one-way, two-way, three-way, and four-way directional control valves
Identify methods of spool actuation for directional control valves

HDL5-Hydraulic Fluid

Identify the characteristics that enable hydraulic fluid to perform required functions within a hydraulic system
Describe the function, structure, and basic operation of reservoirs and accumulators, various types of conductors and fittings, hydraulic seals, and hydraulic filters
Describe the structure and basic operation of various types of hydraulic heat exchangers

HDL6-Hydraulics: System Safety & Maintenance

Identify common hazards associated with the workplace
Describe proper procedures for working with various hydraulic components
List the safety rules that must be followed when operating or maintaining a hydraulic system
Describe the factors that determine the intervals at which proactive maintenance tasks should be performed
Describe the inspections and tests that should be part of a preventative maintenance program

HDL7-The Hydraulic Systems Troubleshooting

Identify the factors that must be considered when evaluating the operation of a hydraulic system
Describe the tasks that should be part of a systematic troubleshooting process
Identify symptoms of several hydraulic components

Identify possible causes of some common hydraulic component and system failures

HPS1-Identification and Operation

Describe the operation of basic hydraulic circuits
Explain how load sensing and demand circuits operate
Describe how intensification and hydrostatic circuits operate
Discuss the operation of regenerative, prefill, and high-low circuits
Explain the importance of using a print when working with hydraulic systems
Describe the procedure for analyzing a complex hydraulic circuit
Identify pressure, drain, and control lines in a hydraulic system
Separate the various functions of a hydraulic circuit for closer analysis

HPS2-Troubleshooting Techniques

Describe proper troubleshooting techniques
Describe various kinds of modern hydraulic system test equipment
Explain how to select proper test points in a circuit
Describe repair procedures when troubleshooting and repairing a hydraulic system
Troubleshoot problems that occur in hydraulic power systems, including lack of motion, poor motion, and temperature and system malfunctions

MEASUREMENT / INTRUMENTATION

PME1 - Thermometers and Thermocouples

Temperature scales
Factors affecting accuracy of measurement
Types of thermometers
Thermocouples

PME3 - Pressure 1: Manometers and Gages

Manometers
Mechanical pressure transducers

PME5 - Level 1: Measurement and Gages

Visual level sensors
Variable displacement devices

PME7 - Flow 1: Measurement Overview

Fluid properties
Measuring flow

BASIC ELECTRCITY / ELECTRICAL MEASUREMENTS

ELS1-Basic Principles

Identify the parts of an atom
Understand how electrons move and react
Define terms associated with electricity, static electricity, and magnetism
Discuss how current flows through basic electrical circuits

ACDC1-Current

Identify the electronic charge of the atom, electron, proton, neutron, nucleus, and ion
Describe Coulomb's Law
Define terms associated with current
Measure current with an ammeter

ACDC2-Voltage

Explain how connecting batteries in series or in parallel will affect voltage and current capability
Differentiate between voltage drop and rise
Explain ground, negative, and positive voltage

Measure voltage with a voltmeter

ACDC3-Resistance

Differentiate between conductors and insulators and describe the characteristics that affect them
Interpret resistor color codes
Describe various types of resistors
Describe how resistors can be connected to achieve different amounts of total resistance

ACDC4-Ohm's Law

Write Ohm's Law in three different forms
Select the proper equation to calculate voltage, current, and resistance
Calculate the amount of power in a circuit

ACDC5-Magnetism

Define electromagnetic terms
Explain basic electromagnetic rules and principles
Describe the operation of generators and motors

ACDC6-Electrical Measurements

Explain how the VOM works and should be connected to a circuit
Calculate the value of shunt required to increase the current capability
Calculate the series dropping resistance required to increase the voltage capability
Define voltmeter loading

ACDC10-AC Measurements

Explain the operation of AC meters and the oscilloscope
Measure alternating current, AC voltage, amplitude, period, and frequency
Analyze phase relationships of AC waveform

(TPC) Electrical Measuring Instruments

Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes.

DC CIRCUITS / FUNDAMENTALS

ACDC7-DC Circuits

Explain how a voltage divider works
Describe an application for a bridge circuit
Describe Kirchhoff's Law
Explain the superposition theorem, Thevenin's Theorem, and Norton's Theorem

ADC2-Ohm's Law and DC Circuits

Understand the various Ohm's law relationships
Understand known and unknown values and how to use the proper Ohm's law relationships to solve for the unknown values
Calculate the total equivalent resistance of series, parallel, and series-parallel resistive currents
Calculate currents and voltages in series and parallel circuits
Understand the proper formula for calculating DC-circuit power
Explain simple rules and formulas for calculating circuit values
Calculate voltages and currents for circuits consisting of both series- and parallel-connected resistors
Determine resistance values for multi-range voltmeter and ammeter circuits
Calculate the power dissipated by each resistor in a series DC circuit
Calculate the power dissipated by each resistor in DC circuits consisting of both parallel- and series-parallel-connected resistors

ADC3-Electronic Components and Magnetism

- Select the proper wire gage and insulation for a specific application
- Explain hole and electron flow in N-type and P-type semiconductor materials
- Understand the operation and function of a diode
- Describe LED and LCD indicators and displays and their advantages and disadvantages
- Understand the operation of bipolar PNP and NPN transistors in switching and amplifier circuits
- Understand passive components such as capacitors, inductors, and resistors
- Identify the different types of magnets and their operating principles
- Explain how a magnetic field can induce current in a conductor
- Identify different types of relays and their applications
- Describe the operation of analog meter movements
- Understand the operation and characteristics of DC motors
- Explain how magnetism deflects the electron beam in a cathode-ray tube (CRT)

ADC4-Electronic Schematics and Circuit Analysis

- Identify the electronic circuit symbols for conductors, connectors, batteries, capacitors, inductors, and various grounded and undergrounded tie points
- Identify the electronic circuit schematic symbols for solid-state devices and other miscellaneous devices
- Identify various types of electronic system documentation and how they are used
- Apply Kirchhoff's current and voltage laws to determine circuit values
- Determine unknown component values in circuits with more than one voltage source
- Calculate simple voltage divider output voltages and currents
- Determine the voltage divider components required to provide specific outputs
- Analyze voltage divider circuits for simple problems, such as component shorts and opens
- Describe the effects of fluctuations in load resistance on voltage divider outputs

AC CIRCUITS / TRANSFORMERS

ELS2-Alternating Current

- Understand the differences between alternating and direct current
- Describe how alternating current is generated
- Learn the difference between single- and three-phase alternating current systems
- Understand inductance and capacitance
- Explain how transformers work

ELS3-Conductors

- Explain the basic principles of conductivity and conductors
- Understand the principles of circuit protection, including fuses and circuit breakers
- Discuss the reasons for grounding electrical components and systems

ACDC8-Inductance & Capacitance

- Define the terms, units, and symbols related to inductance and capacitance
- Explain inductance and capacitance
- Calculate total capacitance and solve time constant problems

ACDC11-Capacitive Circuits

- Describe commonly used capacitors
- Calculate total capacitance for capacitors in series and parallel
- Describe the phase relationships between current and voltage in different types of capacitor circuits
- Calculate impedance in series and parallel RC circuits

ACDC12-Inductive Circuits

- Explain how inductors operate and which features affect them
- Explain mutual inductance

Describe the phase relationship between current and voltage
Compute inductive reactance

ACDC13-AC/DC Electronics: Transformers
Describe the construction and operation of transformers
Describe sources of loss in transformers
Solve problems dealing with turns ratio, voltage ratio, current ratio, and impedance
Describe how the autotransformer and isolation transformer work

ACDC14-Tuned Circuits
Calculate impedance, current, voltage, power factor, and phase angle in RLC circuits
Calculate resonant frequency, capacitance value, or inductance value in RLC circuits
Describe series and parallel resonant circuits
Explain the relationship between bandwidth and Q
Describe four basic types of filters.

MOTOR DRIVES

MTD1-Motor Drive Identification
Identify regenerative and nonregenerative DC drives
Identify voltage source and current source inverters
Understand and identify pulse width modulated inverters
Identify vector control drives

MTD2-Open and Closed Loop Systems
Understand the concept of feedback
Identify open and closed loop systems
Identify direct and inverse feedback
Identify tachometers and understand their use
Identify encoders and understand their use

MTD3-Variable Speed AC Drives
Understand voltage rectification
Identify controlled and uncontrolled rectifiers
Identify silicon-controlled rectifiers
Identify and understand the operation of the DC bus
Identify and understand the operation of the inverter section
Describe the operation of pulse width modulated drives
Describe the operation of vector control in AC drives

MTD4-Servo & Stepper Motors
Identify servo motors and their uses
Understand stepper motor operation
Identify and understand the types of stepper motors and stepper motor controls.

MTD5-AC Motor Operation
Understand how a rotating magnetic field is created
Understand how voltage is induced in a rotor
Understand and calculate slip
Understand and calculate torque and horsepower
Understand and calculate power factor

MTD6-AC Drive Selection and Setup
Determine drive requirements based on motor application
Set up a drive for basic control requirements
Determine run, protection, and stop parameters for common applications

INS6-Operator Inspection: Motor Drive System Inspection

Identify and describe the types and function of drive units
Describe the inspection of three-phase AC induction motors
Describe the inspection of step motors
Describe the inspection of bearings, shafts, and couplings

AC/DC EQUIPMENT & CONTROLS

ELS6-Generators and Motors

Explain the basic differences between motors and generators
Discuss how motors and generators function and are controlled
Understand basic maintenance and troubleshooting techniques

ELS7-AC Motor Control and Current Measurement

Describe motor control devices and methods
Describe different types of motor overload protection devices
Troubleshoot common motor control problems
Determine how to effectively use voltage and current measuring devices

DCM1-DC Motors: Basics and Internal Parts of DC Motors

Identify and locate the basic parts of a DC motor
Describe the effects magnetic fields have on the armature of a motor
Define the right-hand rule
Describe the effects of force and motion on a motor
Explain the physical differences between the various DC motors
Select the proper DC motor for a specific task
Describe the internal construction of a field coil
Locate the poles in a DC motor field
Explain the function of an interpole
Describe the types of windings used in the armature coil
Describe the interaction between coils and other parts of the DC motor
Identify the types of armature construction
Identify the elements of the commutator segment
Describe how connections are made to other parts of the motor
List the types of insulation material used in commutators
Describe how brushes interact with the commutator

DCM2-DC Motors: Wiring Diagrams and Troubleshooting

Read and understand motor wiring diagrams
Connect a motor properly and identify connection errors
Select the proper terminal identifiers
Locate the lubrication ports on a DC motor
Designate the proper lubricant for the DC motor
Identify a bad brush and how to replace it
Detect problems within a DC motor using the correct inspection methods

DCC1-DC Motor Controllers-Controller Function and Operation

Explain basic controller functions
Identify the three types of speed controllers and describe their operation
Describe typical applications for DC motor speed control systems
Define commonly used terms in DC motor control systems
Describe how to control motor speed using a rheostat in the shunt field of a DC motor
Explain how a rheostat in the armature of a DC motor can be used to control the motor's torque
Explain how variable voltage controllers operate
Describe how a chopper controller works

Explain the operation of a single-phase motor controller
Describe the operation of a three-phase motor controller
Identify a Ward/Leonard motor controller and describe its operation

DCC2-DC Motor Controllers-Maintenance and Troubleshooting

Identify each type of maintenance and when it is applicable
List typical inspection procedures to use for DC motor control systems
Identify proper testing procedures for DC motor controllers
Describe proper cleaning procedures for DC motor controllers
Describe the correct troubleshooting technique for a specific problem
Isolate a problem in a DC motor controller

INS5-Operator Inspection: Electrical Equipment Control System Inspection

Understand electricity and control system basics
Identify inspection procedures for equipment main switches, control panels, and external wiring
Identify general inspection procedures for junction boxes, electrical motors, and detectors.

MOTOR CONTROLS

MTR1-Basic Motor Controls & Relays

Describe the three basic types of control systems
Discuss the operation of magnetic relays
Draw schematic symbols for normally open and closed contacts
Draw the standard symbol for a coil
Discuss the operation of solid-state relays

MTR2-Overload Protection Devices

Discuss the difference between overloads and fuses
List the major types of overload relays
Differentiate between the major types of thermal overload relays
Describe the operation of a dashpot timer
List the ways of changing the time setting of a dashpot timer

MTR3-Motor Controls: Time Delay Relays

Describe the operation of an ON delay timer
Describe the operation of an OFF delay timer
Draw the standard NEMA schematic symbols for ON and OFF delay timers

MTR4-Motor Controls: Schematic Symbols

Recognize the symbols used in schematic diagrams
Determine when a contact should be connected normally open or normally closed
Draw schematic diagrams using the proper NEMA symbols

MTR5-Motor Controls: Schematics and Wiring Diagrams

Describe the differences between schematics and wiring diagrams
Determine the logic of a control circuit by reading a schematic diagram
Read a wiring diagram
Convert a schematic diagram into a wiring diagram

MTR6-Motor Controls: Starting Methods for Squirrel Cage Motors

Discuss across the line starting
Explain resistor starting
Describe reactor staring
Discuss auto-transformer starting

MTR8-Motor Controls-Installing/Troubleshooting

Explain the different methods of installing control systems

Describe the steps required to install a control system using terminal strips and identifying wires with numbers
Troubleshoot a control system from a properly installed control cabinet

TRB3-Maintenance Troubleshooting: Motors and Motor Controls

Identify motor and motor control problems
Test motor windings
Wire and troubleshoot two- and three-wire motor control circuits
Troubleshoot variable speed frequency drive systems

BASIC ELECTRONICS

BEC1-Types and Diagrams

Become familiar with various types of electronic diagrams
Become familiar with interconnection diagrams
Read linear and nonlinear scale meters
Calculate circuit values
Understand analog and digital multimeters
List sources of measurement error with VOMs
Define the procedures for measuring voltage and current with an electronic VOM
Define the procedures for measuring resistance with a VOM
Explain the operation of bridge instruments

BEC2-Controls and Application

Identify the basic parts and controls of an oscilloscope and explain how they work
Identify and use the vertical deflection, horizontal deflection, and triggering controls
Check vertical and horizontal calibration
List the steps necessary to align and measure sine wave voltages, frequencies, and DC offset voltages
Identify Lissajous figures
Determine an amplifier's response to a square wave input by identifying the output waveforms

BEC3-Operation and Troubleshooting

Operate RF generators, function and pulse generators, and counter-timers for appropriate signal-testing operations
Identify the steps for troubleshooting a circuit using signal tracking and signal injection
Test the functioning of capacitors and inductors
Test a transformer and calculate transformer power losses
Perform function and specification tests on diodes
Use an ohmmeter to determine transistor types, identify transistor terminals, and test transistors
Use an ohmmeter to test silicon-controlled rectifiers and triacs
Describe the function of semiconductor testers

ECI1-Basic Principles

Define voltage, current, and resistance in operational terms
Calculate voltage, current, and resistance drops in series and parallel circuits
Identify the operation of capacitors in series and parallel circuits and calculate related circuit values
Describe the action of magnetic fields in inductors and how to calculate the inductance of series and parallel circuits
Calculate sine wave values
Describe the relationship between current and voltage in resistive, capacitive, and inductive circuits

ECI2-Characteristics and Operations

Identify circuit configurations of half-wave and full-wave rectifiers and how to compute output voltages from rectifiers

Describe the functions of power supply components and voltage multipliers and how to compute power supply ripple and regulation percent
Describe how to bias transistors and calculate amplifier gains
Identify the circuit configurations and characteristics of basic operational amplifiers
Identify the sequence of events in a tank circuit
Describe the operation and the resonant frequency of a Hartley oscillator
Describe the operation and the resonant frequency of a lag-lead network used in RC oscillators
Describe and determine the characteristics of a pulse waveform, including rise time, pulse width, period, pulse repetition rate, and duty cycle
Identify clipper and clamper circuits
Identify RC and RL differentiating and integrating circuits
Describe the operation of multivibrator and Schmitt-trigger pulse-generation circuits

ECI3-Logic Fundamentals, Types, and Applications

Identify relay circuits arranged to perform AND, OR, and inversion functions
Create truth tables for the inverter and for the AND and OR functions
Count in the binary number system and add and subtract binary numbers
Count in the hexadecimal number system and add and subtract hexadecimal numbers
Count in the octal number system and add and subtract octal numbers
Convert binary, hexadecimal, and octal numbers to decimal equivalents
Identify logic symbols and truth tables for NAND and NOR gates
Identify S-R and J-K flip-flop outputs resulting from different inputs
Describe the uses and functions of shift registers, counters, half adders, and full adders
Identify whether a flip-flop is triggered by a positive or a negative edge of the clock pulse
Describe the operation of bilateral switches and divide-by-N counters
Describe how the modulus of a counter can be changed to some other modulus

PROGRAMMABLE LOGIC CONTROLLERS

PLC1-Fundamentals

Understand how the components of the PLC interact with each other
Discuss the different types of ladder logic
Explain AND, OR, and NOT functions with PLC ladder logic and Boolean identities
Explain the difference between decimal, BCD, binary, hexadecimal, and octal numbering systems
Complete simple conversions

PLC2-Programming

Use programming codes for normally open and normally closed contacts
Program AND, OR, and NOT logic functions with mnemonic codes or ladder logic
Interpret addressing schemes
Properly document a PLC program

PLC3-Inputs and Outputs

Discuss the different types of discrete and analog inputs/outputs
Understand how to use the MOVE and COMPARE functions to handle analog derived inputs
Understand multiplexing wiring schemes

PLC4-Troubleshooting

Understand how to use the troubleshooting devices and functions common to most PLCs
Troubleshoot a PLC system for a problem

PLC5-Communications and Advanced Programming

Discuss PLC communications
Program the Add, Subtract, Multiply, and Divide math functions
Program the One Shot, R-S, D, and T Flip-Flops

Use the Sub-routine commands JUMP, SKIP, and MCR
Understand how to use the Sequencer function

RSX1-Configuring Hardware and Software

Identify the hardware necessary for communicating with the PLC
Create and configure drivers
Access the software and select drivers
Go online to the PLC and access essential help functions

RSX2-Programming and Editing

Open a new file, add rungs and instructions, edit and address, and add comments and symbols
Verify, save, and download files
Edit online and access program files

RSX3-Testing/Troubleshooting Functions

Apply forcing in RSLogix™
Understand forcing conventions, inputs, and outputs
Understand data monitors and searches, including histograms
Discuss advanced tools such as configuring intelligent modules and trending

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