

ELECTROMECHANICAL II

COURSE DESCRIPTION

Electromechanical II is a course in which students will learn and practice intermediate skills related to operation and maintenance of electrical, instrumentation, and mechanical (electromechanical) systems found in a typical manufacturing facility. Topics covered include basic MIG (metal inert gas) welding, mechanical transmission, piping and auxiliaries, basic hydraulics, basic digital electronics, advanced troubleshooting, smart instrumentation, basic programmable logic controller operation, intro to gear, centrifugal, positive displacement pumps, and a laboratory experience for students for all of topics. This course gives students the intermediate skills and knowledge needed to enter a post-secondary Electromechanical Associates Degree program and prepares students for an electromechanical career within a manufacturing facility.

It is strongly recommended that administration and guidance follow the scope and sequence and course recommendations as listed.

Recommended: Algebra I, Principles of Technology I or Physical Science, Geometry

Recommended Credits: 1

Recommended Grade Level(s): 11TH and 12th

Number of Competencies in Course: 32

ELECTROMECHANICAL II

STANDARDS

- 1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 2.0 Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.
- 3.0 Students will set up a MIG (metal inert gas) welder for proper operation and perform the five basic types of welds: lap joint, butt joint, corner joint, edge joint and T-joint.
- 4.0 Students will set up a typical mechanical drive system (gear and belt drive) found in an industrial setting.
- 5.0 Students will perform basic **pipng and auxiliaries (including bolted flange, screw pipe, etc.) found in a typical industrial setting.**
- 6.0 Students will explain the theory, component operation, and fluid power in a **basic industrial hydraulics system.**
- 7.0 Students will construct and test fundamental **basic digital logic circuits (gates, counters, oscillators, and switches).**
- 8.0 Students will demonstrate **advanced troubleshooting techniques.**
- 9.0 Students will setup, identify instrument parameters, and change instrument calibration of **smart instrumentation using the proper communicator.**
- 10.0 Students will explain the operation of a **basic programmable logic controller.**
- 11.0 Students will explain the basic operation of **gear, centrifugal, and positive displacement pumps typically found in industrial settings.**

ELECTROMECHANICAL II

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

- 1.1** Demonstrate leadership skills.
- 1.2** Use problem-solving techniques to address and propose solutions to school, community, and workplace problems.
- 1.3** Demonstrate the ability to work professionally with others.
- 1.4** Participate in SkillsUSA as an integral part of instruction.
- 1.5** Exhibit integrity and pride in artisanship.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 1.1A** Uses critical-thinking and consensus building skills in-group deliberations.
- 1.1B** Keeps group work focused on task.
- 1.2A** Determines the root causes of observed conflicts or problems.
- 1.2B** Mediates disputes between parties.
- 1.3A** Participates in a job shadowing experience.
- 1.3B** Assembles a student team to solve an assigned problem.
- 1.4** Attends and participates in periodic meetings of SkillsUSA or similar organization.
- 1.5** Exhibits integrity and pride in artisanship.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Participate in various SkillsUSA or similar programs and/or competitive events.
- Attend a professional organization meeting, such as local Chamber of Commerce meeting.
- Participate in the American Spirit Award competition with SkillsUSA.
- Participate in job shadowing or internship program with local business or industry.
- Take an active role in a group project assigned by the instructor.
- Identify and detail a problem area in the school, community, or workplace, and propose solutions. If possible, and with appropriate approvals, implement or facilitate the solution.

INTEGRATION LINKAGES

SkillsUSA *Professional Development Program (PDP)*, SkillsUSA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Algebra, Geometry, English IV Communications for Life, Algebra, Geometry, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills,

Multistate Academic and Vocational Curriculum Consortium (MAVCC), SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

ELECTROMECHANICAL II

STANDARD 2.0

Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.

LEARNING EXPECTATIONS

The student will:

- 2.1** Exhibit and encourage in others a positive attitude regarding safety practices and issues.
- 2.2** Habitually inspect and use appropriate personal protective equipment for assigned tasks.
- 2.3** Inspect, maintain, and employ safe operating procedures with tools and equipment, such as scaffolding, lifting equipment, and air-powered drivers.
- 2.4** Exhibit a well-developed awareness of potential hazards to self and others.
- 2.5** Carry out responsibilities under HazCom (Hazard Communication) regulations.
- 2.6** Take action to protect coworkers and bystanders from hazards as required by regulations and Occupational Safety and Health Administration (OSHA) policies.
- 2.7** Report accidents and observed hazards and execute emergency response procedures as required by regulations and Occupational Safety and Health Administration (OSHA) policies.
- 2.8** Demonstrate appropriate industrial-related safety procedures.
- 2.9** Pass with 100 % accuracy a written examination relating specifically to electromechanical safety issues
- 2.10** Maintain a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 2.1A** Includes safety procedures in activity plans.
- 2.1B** Exhibits an awareness of proper safety procedures by coworkers.
- 2.1C** Responds positively to instruction, advice, and correction regarding safety issues.
- 2.1D** Reports to school or work physically ready to perform to professional standards, such as, rested or not impaired by medications, drugs, alcohol, and so forth.
- 2.2** Selects, inspects, and uses the correct personal protective equipment for the assigned task.
- 2.3A** Checks scaffolding for stability, bracing, walk boards, and guard rails prior to use.
- 2.3B** Inspects extension cords for the presence of a functional ground connection, prior to use.
- 2.4A** Is observant of personnel and activities in the vicinity of the work area.
- 2.4B** Warns nearby personnel, prior to starting potentially hazardous actions
- 2.5A** Applies information from material safety data sheet (MSDS) to protect self and others from the health hazards associated with assigned tasks.

- 2.5B** Reports hazards found on the job site to the supervisor and remedies the hazard as instructed.
- 2.6A** Warns and protects workers and bystanders of overhead loads in transit.
- 2.6B** Provides and activates adequate ventilation equipment as required by the task.
- 2.7A** Reports all injuries and observed unguarded hazards to the immediate supervisor.

- 2.7B** Executes assigned tasks as described in emergency response procedures.
- 2.8A** Is observant of safety issues and concerns relevant to the construction industry
- 2.8B** Complies with all safety guidelines and regulations set forth by industry and Occupational Safety and Health Administration (OSHA).
- 2.9** Passes with 100 % accuracy a written examination relating specifically to electromechanical issues.
- 2.10** Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Prior to assigning a task using power tools, the instructor removes some required safety items and instructs students to perform an inspection of tools.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- In a project requiring solvents or adhesives, introduce a new brand or type and require students to retrieve the MSDS and identify possible health hazards.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers (IBEW)

ELECTROMECHANICAL II

STANDARD 3.0

Students will set up a MIG (metal inert gas) welder for proper operation and perform the five basic types of welds: lap joint, butt joint, corner joint, edge joint and T-joint.

LEARNING EXPECTATIONS

The student will:

- 3.1** Interpret dimensions and specifications on a welding sketch, correctly set up a MIG welder, safely perform a lap joint, butt joint, corner joint, edge joint, and t-joint weld.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 3.1A** Correctly sets up the MIG welder for a lap joint, butt joint, corner joint, edge joint, and t-joint weld.

SAMPLE PERFORMANCE TASKS

This is sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Given a set of specifications for a weld and a specific type of metal, make a lap joint, butt joint, corner joint, edge joint, and t-joint weld.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 4.0

Students will set up a typical mechanical drive system (gear and belt drive) found in an industrial setting.

LEARNING EXPECTATIONS

The student will:

- 4.1** Correctly setup a typical gear driven mechanical drive.
4.1.1 Correctly setup a typical belt driven mechanical drive.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 4.1A** Safely and correctly disassemble a typical gear driven mechanical drive.
- 4.1B** Safely and correctly assemble a typical gear driven mechanical drive.
- 4.1C** Safely and correctly disassemble a typical belt driven mechanical drive.
- 4.1D** Safely and correctly assemble a typical belt driven mechanical drive.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Given a working gear driven mechanical drive, the student will correctly disassemble and reassemble the drive in a specified amount of time .
- Given a working belt driven mechanical drive, the student will correctly disassemble and reassemble the drive in a specified amount of time .

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 5.0

Students will perform basic **piping and auxiliaries (including bolted flange, screw pipe, etc.) found in a typical industrial setting.**

LEARNING EXPECTATIONS

The student will:

- 5.1** Put together a bolted flange assembly, given a piping sketch.
- 5.2** Put together a screw pipe assembly, given a piping sketch.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 5.1A** Views a piping sketch, selects necessary piping parts, and assembles a bolted flange assembly.
- 5.1B** Views a piping sketch, selects necessary piping parts, and assembles a screw flange assembly.

SAMPLE PERFORMANCE TASKS

This is a sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Assemble various types of piping assemblies, given sketches, a general piping parts.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 6.0

Students will explain the theory, component operation, and fluid power in a **basic industrial hydraulics system**.

LEARNING EXPECTATIONS

The student will:

- 6.1** Explain how to minimize failures in hydraulic equipment.
- 6.2** Perform regular preventive maintenance on hydraulic equipment and controls.
- 6.3** Interpret ANSI symbols and drawings to explain the functions of specific hydraulic parts.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 6.1A** Explains how to minimize failures in hydraulic equipment.

6.1B Performs preventive maintenance on hydraulic equipment.

6.1C Interpret ANSI symbols and drawings to explain the functions of specific hydraulic parts.

SAMPLE PERFORMANCE TASKS

This is a sample project of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Determine (troubleshoot) an operational hydraulic system.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), Multistate Academic and Vocational Curriculum Consortium (MAVCC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 7.0

Students will construct and test fundamental **basic digital logic circuits (gates, counters, oscillators, and switches)**.

LEARNING EXPECTATIONS

The student will:

7.1 Construct logic circuits using gates..

7.2 Construct logic circuits using flip-flops, counters, and gates.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

7.1A Analyzes the function of gates in logic circuits.

7.1B Constructs logic circuits using AND, OR, NOR, and XOR gates as described by logic statements and schematic circuits.

7.1C Analyzes the function of flip-flops, counters, and gates in logic circuits.

7.1D Constructs logic circuits using flip-flops, counters, and gates as described by given logic statements and schematic circuits.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Create a circuits wing AND,OR, NOR, and XOR gates to execute given Boolean expressions based on several inputs.
- Create circuits using flip-flops to act as a counter.

INTEGRATION LINKAGES

International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology*. International Technology Education Association. Reston, VA, 2000. Mathematics concepts and skills. Computer Science concepts and skills.

ELECTROMECHANICAL II

STANDARD 8.0

Students will demonstrate **advanced troubleshooting techniques**.

LEARNING EXPECTATIONS

The student will:

8.1 Troubleshoot an electromechanical system.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

8.1 Given blueprints of a typical electromechanical system and after confirming the correct operation of an operational electromechanical system, will systematically and logically troubleshoot, within a given amount of time, the system after the instructor has put in a problem.

SAMPLE PERFORMANCE TASKS

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion

- Instructor sets up an operational electromechanical system (motor driving a pump with a coupling, an instrumentation loop, etc.) and ensures the student understands the system. The instructor then puts a problem in the system and takes the role of an operator and tells the student about the symptoms of the problem. The student then begins to diagnose/troubleshoot the system. The student is given a definite amount of time to systematically and logically troubleshoot the problem.

INTEGRATION LINKAGES

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, English IV Communications for Life, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), Multistate Academic and Vocational Curriculum Consortium (MAVCC), National Center for Construction Education and Research (NCCER), International Brotherhood of Electrical Workers, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 9.0

Students will setup, identify instrument parameters, and change instrument calibration of **smart instrumentation using the proper communicator.**

LEARNING EXPECTATIONS

The student will:

- 9.1** Correctly set up a communication loop for a smart pressure, flow, temperature, or level-measuring instrument.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 9.1A** Correctly set up communication loop for a smart pressure, flow, temperature, or level-measuring instrument.

SAMPLE PERFORMANCE TASKS

This is a sample project of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Given a working smart instrument and its corresponding communicator (Honeywell or Rosemount instrument and its communicator), the student will set up the communication loop, determine the basic parameters of the instrument (tag number, calibration range, etc.) and change one parameter of the instrument.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 10.0

Students will explain the operation of a **basic programmable logic controller**.

LEARNING EXPECTATIONS

The student will:

10.1 Correctly set up a communication loop for a basic programmable logic controller.

10.2 Correctly identify the basic parts of a programmable controller and their function.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

10.1A Safely and correctly connect a communication loop between an interfacing computer and a basic programmable logic controller.

10.1B Correctly identify the parts of a programmable controller and their specific functions (power supply, CPU, input modules, output modules, analog input and/or modules).

SAMPLE PERFORMANCE TASKS

This is a sample project of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Given a working PLC, an operator interface, and an interfacing computer, the student will use software allowing a user to see the PLC's program, the student will set up a communication loop, view the program and explain the program's purpose, and identify the basic parts of a programmable logic controller.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

STANDARD 11.0

Students will explain the basic operation of **gear, centrifugal, and positive displacement pumps typically found in industrial settings.**

LEARNING EXPECTATIONS

The student will:

- 11.1** Explain the basic operation of a **gear pump.**
- 11.2** Explain the basic operation of a **centrifugal pump.**
- 11.3** Explain the basic operation of a **positive displacement pumps.**

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 11.1A** Tear down and reassemble a gear pump.
- 11.2A** Tear down and reassemble a centrifugal pump.
- 11.3A** Tear down and reassemble a positive displacement pump.

SAMPLE PERFORMANCE TASKS

This is a sample project of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Given a gear pump, centrifugal pump, and a positive displacement pump, the student will safely and successfully tear down the pump, identify the basic parts of each pump, and reassemble the pump.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English IV Communications for Life, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

ELECTROMECHANICAL II

SAMPLING OF AVAILABLE RESOURCES

- *Core Curriculum*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
- *Welding Level One*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
- Multistate Academic and Vocational Curriculum Consortium (MAVCC), Oklahoma Department of Vocational and Technical Education
- *Total Quality Curriculum*, National SkillsUSA
- Professional Development Program, National SkillsUSA—www.skillsusa.org
- Power Tool Institute, www.powertoolinstitute.com
- Fluke Educators Portal, <http://support.fluke.com/educators>
- National Association of Home Builders, www.nahb.org
- International Brotherhood of Electrical Workers, www.ibew.org
- National Association of Women in Construction, www.nawiceducation.org
- Homebuilders Institute, www.hbi.org
- United States Department of Labor, www.dol.gov
- United States Department of Labor, Occupational Outlook Handbook, www.dol.gov (link)
- Secretary's Commission on Achieving Necessary Skills, www.dol.gov (link)
- Occupational Safety and Health Administration (OSHA), www.osha.gov
- Environmental Protection Agency (EPA), www.epa.gov
- National Safety Council, www.nsc.org
- National Skills Standards Board Institute, www.nssb.org
- Vocational Information Center, www.khake.com
- Power Tool Institute (PTI), www.powertoolinstitute.com

- Associated Builders and Contractors, www.abc.org
- Associated General Contractors of America, www.agcofamerica.org
- Building Officials and Code Administration International, www.bocai.org