Energy & Manufacturing Systems: Scope & Sequence

(141 days class, 219 days lab, 61% lab)

Year 1, Semester 1

EIT101 Energy & Manufacturing Systems I
(90 days) (37 Days Classroom, 53 Days Lab, 69% Lab)

District Pre-Assessment

Unit 1 (10 Days – 8 class, 2 lab
(20 Classroom Hours, 5 Lab Hours)

Basic Safety:

- Demonstrate knowledge of safety, health, and environmental rules and regulations to avoid workplace injury and maximize machine productivity.
- Demonstrate knowledge of electrical safety standards and electrical procedures to maintain industrial equipment safely.
- Demonstrate knowledge of safety practices of mechanical and fluid-controlled systems to maintain industrial equipment safely.
- Demonstrate knowledge of proper fall protection.
- Select appropriate Personal Protective Equipment (PPE) for various industrial safety situations.
- Describe how to appropriately use Personal Protective Equipment (PPE) for various industrial safety situations.

CTSO Integration (Leadership Skills): SkillsUSA Officer Elections and Training
Professional Skills: 1. A-D, 4 . A-F, 7. A-C
Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7
Work-based Learning: Industry Guest Speaker, Mock Interview, Job Application
Technical Standards: 3.1-3.13

Unit 2 (40 Days - 15 class, 25 lab
(37.5 Classroom Hours, 62.5 Lab Hours)

Maintenance Operations:

- Machine Operation, Safety Systems & Production Performance
- Maintenance Strategies, TPM, CMMS & Predictive Maintenance
- Troubleshooting, Root Cause Analysis & Workplace Organization
- Maintenance Documentation, Technical Drawings & GD&T
- Rigging, Hand Tools, Power Tools & Fasteners
- Measurement Tools, OEE & Integrated Maintenance Application.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Preparation
Professional Skills: 2. A-C, 4 . A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4, ELA.11-12.L.4
Work-based Learning: Industry Guest Speaker
Technical Standards: 4.1-4.8, 5.1-5.6, 12.1-12.8

Unit 3 (40 Days – 15 class, 25 lab
(37.5 Classroom Hours, 62.5 Lab Hours)

Fundamentals of Mechanical Drives:

- Mechanical Power Systems, Motor Mounts & Shaft Alignment
- Couplings, Bearings & Precision Alignment
- V-Belt & Synchronous/Timing Belt Drives
- Chain Drives, Sprockets & Bushings
- Gear Drives & Mechanical Drive Troubleshooting
- Horsepower, Torque, Speed, Power & Efficiency
- Lubrication Fundamentals & Lubrication Systems
- Integrated Mechanical Drive Installation, Performance & Troubleshooting

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Prep
Professional Skills: 2. A-C, 4 .A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4, ELA.11-12.L.4
Work-based Learning: Industry Guest Speaker
Technical Standards: 5.1-5.6
Certifications: NC3 Fundamentals of Mechanical Systems (Level 1)

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Year 1, Semester 2

EIT102 Energy & Manufacturing Systems II
(90 days) 48 days class, 72 days lab, 67% lab)

Unit 4 (30 Days - 12 class, 18 lab
(30 Classroom Hours, 45 Lab Hours)

Applied Mechanical Drives II:

- Apply safety principles about mechanical drive components and systems.
- Read and interpret technical documents about mechanical drive components and systems.
- Explain fundamental theories related to mechanical drive components and systems.
- Solve technical problems related to mechanical drive components and systems using equations and mathematical principles.
- Describe the operation of mechanical drive components and systems.
- Solve technical problems related to mechanical drive components and systems using equations and mathematical principles.
- Troubleshoot mechanical drive components and systems.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Prep
Professional Skills: 2. A-C, 4 . A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4, ELA.11-12.L.4
Work-based Learning: Industry Guest Speaker
Technical Standards: 4.1-4.8, 5.1-5.6

Certifications: NC3 Applied Mechanical Systems (Level 2)

Unit 5 30 Days – 10 class, 20 lab
(25 Classroom Hours, 50 Lab Hours)

Fluid Power - Hydraulics:

- Apply safety principles when working with hydraulic components, piping systems, pumps, valves, accumulators, and pressurized fluid systems.
- Read and interpret hydraulic technical documents, schematics, symbols, diagrams, manufacturer specifications, and system documentation.
- Explain fundamental fluid power and hydraulic theories, including Pascal's Law, pressure, flow, force, displacement, energy transfer, power, and system efficiency.
- Apply principles related to fluid flow, including Bernoulli's principle and the relationship between pressure, velocity, and flow.
- Identify hydraulic fluid types and explain how fluid properties, viscosity, temperature, and contamination affect hydraulic system performance and efficiency.
- Solve technical problems related to hydraulic systems using equations and mathematical principles for pressure, force, area, flow rate, displacement, horsepower, power, and efficiency.
- Describe the operation and function of hydraulic power units, reservoirs, pumps, accumulators, cylinders, motors, and actuators.
- Describe the operation and application of positive-displacement hydraulic pumps and identify common pump performance problems.
- Identify and describe directional control, pressure control, flow control, relief, and check valves used in hydraulic systems.
- Explain the function and proper application of hydraulic piping, tubing, hoses, fittings, seals, conductors, and connectors.
- Explain the purpose and operation of filters, strainers, contamination-control devices, heat exchangers, and other fluid-conditioning components.
- Identify and analyze series, parallel, open-loop, closed-loop, and common hydraulic circuits using standard fluid-power symbols.
- Select and appropriately size basic hydraulic components based on system pressure, flow, force, speed, and application requirements.
- Use tools, gauges, meters, sensors, and test instruments to assemble, operate, inspect, measure, and maintain hydraulic systems.
- Measure and evaluate hydraulic pressure, flow, temperature, actuator speed, force, and overall system performance and efficiency.
- Explain the use of electrical and electronic sensing and control devices in electrohydraulic systems.
- Perform preventive maintenance procedures, including fluid inspection, filtration, leak inspection, component inspection, and contamination control.
- Troubleshoot hydraulic systems to identify leaks, pressure loss, flow restrictions, overheating, cavitation, contamination, valve problems, pump problems, and actuator failures.
- Inspect and analyze hydraulic component and system failures and determine appropriate corrective actions.
- Construct, operate, test, adjust, and troubleshoot hydraulic circuits in a laboratory environment.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Regional and State Competition
Professional Skills: 3. A-E, 4 . A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 7.RP.A.3, 6.EE.A.2
Work-based Learning: Industry Guest Speaker, Resume and Cover Letter, Mock Interview, School-Based Enterprise
Technical Standards: 8.1-8.10, 9.1-9.8, 10.1-10.8

Certifications: NC3 Fundamentals of Fluid Power - Hydraulics (Level 1)

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Unit 6 30 Days – 10 class, 20 lab
(25 Classroom Hours, 50 Lab Hours)

Fluid Power - Pneumatics:

- Apply safety principles when working with pneumatic components, compressed-air systems, vacuum systems, piping, valves, and stored pneumatic energy.
- Read and interpret pneumatic technical documents, schematics, symbols, diagrams, manufacturer specifications, and system documentation.
- Explain fundamental fluid power and pneumatic theories, including pressure, flow, force, volume, energy transfer, power, and system efficiency.
- Explain the properties and behavior of compressed gases and apply basic gas laws to pneumatic system operation.
- Solve technical problems related to pneumatic systems using equations and mathematical principles for pressure, force, area, airflow, volume, actuator speed, power, and efficiency.
- Describe the operation and function of air compressors, receivers, cylinders, rotary actuators, pneumatic motors, and other pneumatic components.
- Describe compressor operation and identify common compressor types, applications, maintenance requirements, and operating problems.
- Identify and describe directional control, pressure control, flow control, relief, check, and other valves used in pneumatic systems.
- Explain the function and proper application of pneumatic piping, tubing, hoses, fittings, seals, conductors, and connectors.
- Describe the purpose and operation of filters, regulators, lubricators, separators, dryers, receivers, and other air-preparation and conditioning components.
- Explain the principles and operation of vacuum systems, vacuum pumps/generators, vacuum actuators, and related components.
- Identify and analyze series, parallel, sequential, and common pneumatic circuits using standard fluid-power symbols.
- Select and appropriately size basic pneumatic components based on pressure, airflow, force, speed, and application requirements.
- Use tools, gauges, flowmeters, sensors, and test instruments to assemble, operate, inspect, measure, and maintain pneumatic and vacuum systems.
- Measure and evaluate pneumatic pressure, airflow, vacuum, actuator speed, force, and overall system performance and efficiency.
- Explain the use of electrical and electronic sensing and control devices, including solenoid-operated valves, switches, and sensors, in electro-pneumatic systems.
- Perform preventive maintenance procedures on compressors, air-preparation equipment, valves, actuators, piping, and vacuum components.
- Troubleshoot pneumatic systems to identify air leaks, pressure loss, flow restrictions, contamination, moisture problems, valve malfunctions, compressor problems, and actuator failures.
- Troubleshoot vacuum systems and identify malfunctioning components and performance problems.
- Inspect and analyze pneumatic component and system failures and determine appropriate corrective actions.
- Construct, operate, test, adjust, and troubleshoot pneumatic and electro-pneumatic circuits in a laboratory environment.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Regional and State Competition
Professional Skills: 3. A-E, 4 . A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 7.RP.A.3, 6.EE.A.2
Work-based Learning: Industry Guest Speaker, Resume and Cover Letter, Mock Interview, School-Based Enterprise
Technical Standards: 8.1-8.10, 9.1-9.8, 10.1-10.8

***District Post Assessment**

Certifications: NC3 Fundamentals of Fluid Power - Pneumatics (Level 1)

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Year 2, Semester 1

EIT201 Energy & Manufacturing Systems III
(90 days) (36 days class, 54 days lab, 60% lab)

Unit 1 (20 Days- 5 Class, 15 lab)
(12.5 Classroom Hours, 37.5 Lab Hours)

Introduction to the Power Industry:

- Define energy and identify conventional, emerging, and alternative energy sources.
- Describe the flow of energy from generation through transmission and distribution to the customer.
- Describe electric power generation, transmission, and distribution systems and the organizations that support each function.
- Identify the different methods of converting energy into electricity.
- Explain how electricity is transmitted and distributed through the U.S. electrical grid.
- Describe the structure of the energy industry, including investor-owned utilities, municipalities, electric cooperatives, independent power producers, regulatory bodies, and energy business lines.
- Describe the economics of power generation, transmission, and distribution, including metering, billing, efficiency, and infrastructure costs.
- Describe the environmental impacts of producing and distributing electricity and the laws, regulations, and methods used to minimize negative effects.
- Apply basic energy-industry safety principles, including OSHA requirements, PPE, lockout/tagout, hazard recognition, reporting unsafe conditions, and safe work practices.
- Explain fundamental concepts of natural gas transmission and distribution, including metering and regulating stations.
- Identify career opportunities, education and training requirements, advancement opportunities, and career pathways in the energy industry.
- Identify and evaluate concerns and emerging issues that may affect the future of the power industry.
- Explain the need for alternative energy and identify wind, solar, biomass, geothermal, wave, and other emerging energy technologies.
- Describe the contributions, advantages, limitations, and future potential of alternative energy sources.
- Describe the present U.S. electrical grid and analyze issues affecting alternative-energy integration, reliability, Smart Grid development, distribution automation, and economic impact.
- Evaluate energy efficiency, conservation, Time-of-Use technologies, and other current energy-industry hot topics.

CTSO Integration (Leadership Skills): SkillsUSA Officer Elections and Training

Professional Skills: 5. A-E, 6. A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.L.4, ELA.11-12.S, 5.NF.B.7, 7.EE.B.3

Work-Based Learning: Industry Guest Speaker, Job Application

Technical Standard: 2.1-2.9

Unit 2 (40 Days- 15 class, 25 lab)
(37.5 Classroom hours, 62.5 Lab Hours)

Fundamentals of AC/DC

- Apply safety principles when working with direct current (DC) and alternating current (AC) electrical/electronic components and circuits.
- Read and interpret electrical technical documents, circuit diagrams, schematics, symbols, wiring diagrams, and manufacturer specifications for AC and DC systems.
- Explain fundamental electrical theories related to AC and DC circuits, including electric charge, voltage, current, resistance, power, magnetism, capacitance, inductance, and electromagnetic principles.
- Apply Ohm's Law, Kirchhoff's Voltage Law (KVL), and Kirchhoff's Current Law (KCL) to analyze electrical circuits.
- Analyze series, parallel, and combination circuits to determine voltage, current, resistance, power, current flow, and voltage drops.
- Solve technical problems related to AC and DC circuits using equations and mathematical principles.
- Use multimeters, clamp meters, and other electrical test instruments to measure voltage, current, resistance, continuity, and circuit performance.
- Identify and describe the operation and application of resistors, capacitors, inductors, solenoids, relays, transformers, and other basic electrical/electronic components.
- Identify and describe the operation and application of control and sensing devices, including capacitive, inductive, photoelectric, and proximity sensors; magnetic reed switches; limit switches; float switches; and pressure switches.
- Describe the operation of DC electric motors and single-phase AC motors and explain their application in electrical and industrial systems.
- Explain transformer operation and apply principles related to voltage change, current load, resistance, sizing, and turns ratio.
- Select and test electrical circuit-protection devices, including fuses, circuit breakers, and Ground-Fault Circuit Interrupters (GFCIs), in accordance with applicable National Electrical Code (NEC) requirements.
- Identify and apply basic electrical wiring requirements, including wiring color codes, wire gauge, wire size, and ampacity.

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- Use electrical test instruments to inspect and test resistors, capacitors, inductors, solenoids, relays, transformers, motors, sensors, switches, wiring, and circuit-protection devices.
- Troubleshoot AC and DC electrical/electronic circuits to identify opens, shorts, component failures, wiring faults, control-device malfunctions, and other basic electrical problems.
- Construct, operate, test, measure, and troubleshoot AC and DC electrical circuits in a laboratory environment.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Prep
Professional Skills: 1. A-D, 5. A-E, 8 . A-I
Academic Standards: ELA.11-12.L.4, ELA.11-12.SL.5, 5.NF.B.7, 7.EE.B.3
Work-Based Learning: Industry Guest Speaker
Technical Standards: 1.1-1.9, 11.1-11.10

Certification: NC3 Fundamentals of Electricity - AC, NC3 Fundamentals of Electricity - DC
EMCC Level 1 AIT Certification

Unit 3 (30 Days- 10 class, 20 lab)
(25 Classroom Hours, 50 Lab Hours)

Industrial Controls:

- Apply safety principles about industrial control components and circuits.
- Read and interpret technical documents about industrial control components and circuits.

Foundations of Instrumentation:

- Theory of instrumentation
- Types of measurements
- Process of measurements

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Prep
Professional Skills: 2. A-C, 4. A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4, ELA.11-12.L.4
Work-based Learning: Industry Guest Speaker
Technical Standards: 6.1-6.6, 7.1-7.5

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Year 2, Semester 2

EIT202 Energy & Manufacturing Systems IV
(90 days - 20 class days, 39 lab days, *capstone)

Unit 4 (28 Days- 10 class, 18 lab)
(25 Classroom Hours, 45 Lab Hours)

Process Instrumentation:

- Apply safety principles about process instrumentation components and circuits.
- Read and interpret technical documents about process instrumentation components and circuits.
- Explain fundamental theories related to process instrumentation components and circuits.
- Solve technical problems related to process instrumentation components and circuits using equations and mathematical principles.
- Describe the operation of process instrumentation components and circuits.
- Use tools and instruments to operate and maintain process instrumentation components and circuits.
- Troubleshoot process instrumentation components and circuits.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Nationals
Professional Skills: 8. A-I, 9 . A-C
Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 8.G.B.7
Work-Based Learning: Industry Guest Speaker, Field Trip
Technical Standards: 3.1-3.13

Certification: NC3 Applied Motor Controls

Unit 5 (31 Days- 10 class, 21 lab) (Q4)
(25 Classroom Hours, 52.5 Lab Hours)

Fundamentals of PLCs:

- Apply safety principles about programmable logic controllers.
- Read and interpret technical documents about programmable logic controllers.
- Explain fundamental theories related to programmable logic controllers.
- Solve technical problems related to programmable logic controllers using equations and mathematical principles.
- Describe the operation of programmable logic controllers.
- Use tools and instruments to operate and maintain programmable logic controllers.
- Troubleshoot programmable logic controllers.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference, Regionals Prep
Professional Skills: 2. A-C, 4. A-F
Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4, ELA.11-12.L.4
Work-based Learning: Industry Guest Speaker
Technical Standards: 3.1-3.13, 4.0, 5.0

**Energy/Robotics Crossover Project (PLCs)*

Certifications: NC3 STEM Introduction to PLCs and Smart Sensor Technology

CAPSTONE PROJECT: Applied Fluid Power

Common AZCCR Math Standards (CAMS)
English Language Art Standards (ELAS)
The National Coalition of Certification Center (NC3)

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