Missouri CTE

Engineering Principles (2025)

Business Operations/21st Century Skills: Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field. 1

1 **Employability Skills: Develop career awareness and employability skills (e.g. face-to-face, online) needed for gaining and maintaining employment in diverse business settings.** 1.1

1 Identify the knowledge, skills, and abilities necessary to succeed in careers. 1.1.1

2 Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience. 1.1.2

3 Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options. 1.1.3

4 Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships. 1.1.4

5 Develop strategies for self-promotion in the hiring process (e.g. filling out job applications, résumé writing, interviewing skills, portfolio development). 1.1.5

6 Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles. 1.1.6

7 Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions. 1.1.7

8 Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism. 1.1.8

9 Give and receive constructive feedback to improve work habits. 1.1.9

10 Adapt personal coping skills to adjust to taxing workplace demands. 1.1.10

11 Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them. 1.1.11

12 Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits and abusive behavior. 1.1.12

3 **Business Ethics and Law: Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.** 1.3

1 Analyze how regulatory compliance affects business operations and organizational performance. 1.3.1

Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment. 1.3.2

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3 Use ethical character traits consistent with workplace standards (e.g. honesty, personal integrity, compassion, justice). 1.3.3

5 Access and implement safety compliance measures (e.g. quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization. 1.3.5

7 Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g. harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission). 1.3.7

8 Verify compliance with computer and intellectual property laws and regulations. 1.3.8

9 Identify potential conflicts of interest (e.g. personal gain, project bidding) between personal, organizational, and professional ethical standards. 1.3.9

Electrical/Electronics: Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and operations, wiring components to construct a communications system and providing power to an electrical system. 2

1 **Electrical and Electronic Theory: Explain electrical and electronic principles and theory.** 2.1

4 Compare alternating current (AC) and direct current (DC). 2.1.4

5 Define the units of measurement for voltage, current, power and resistance. 2.1.5

6 Describe the relationships between voltage, current, resistance and power in circuits. 2.1.6

7 Determine voltage, current, resistance and power in circuits using Ohm's Law, Kirchhoff's Law and Watt's Law. 2.1.7

3 **Electronic Components: Describe the functions and purposes of electronic components** 2.3

3 Identify symbols for electronic components. 2.3.3

Mechanical Systems: Learners apply pri po pneumatics, mechanical

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1 **Motors and Power: Install motors, variable-frequency drives (VFD), and power wiring.** 3.1

Identify types and components of single phase and three phase motors. 3.1.1

2 Interpret motor nameplate information and motor specifications. 3.1.2

drives, pumping systems, and cleanroom vacuum systems. They gain essential knowledge and skills in installing, maintaining, and troubleshooting various mechanical systems used in engineering and manufacturing. 3

3 Calculate motor loads. 3.1.3

2 **Hydraulics and Pneumatics Systems: Install, maintain, and Hydraulic and Pneumatic systems** 3.2

1 Understand and explain the fundamental principles of hydraulics and pneumatics system (e.g., Pressure, Flow, and Force) 3.2.1

2 Identify the major components of hydraulics and pneumatics systems (e.g., pumps, cylinders, valves, and compressors) 3.2.2

3 Describe the properties of fluids used in hydraulics systems including viscosity, density, and compressibility. 3.2.3

4 Describe the properties of gases used in pneumatic systems including viscosity, density, and compressibility. 3.2.4

3 **Mechanical Drives Systems: Install, maintain, and monitor mechanical drives systems.** 3.3

1 Compare types of gears, couplings, belts and chains and describe their uses. 3.3.1

4 **Pumping Systems: Install, maintain, and troubleshoot pumps and pumping systems.** 3.4

1 Understand and explain the fundamental principles of pumps and pumping systems. 3.4.1

2 Identify the major components of pumps and pumping systems. 3.4.2

3 Interpret a basic schematic of a pumping system identifying the components of that system within the schematic. 3.4.3

Pre-Engineering: Design and Development: Learners apply principles of design and development related to the design process, sketching and visualization, modeling, drafting, materials and production and process design. 5

1 **The Design Process: Use the engineering design process and quality assurance principles to analyze and solve design problems.** 5.1

1 Define the goal of a design. 5.1.1

2 Describe the role of research, development and experimentation in design problem solving. 5.1.2

3 Conduct an investigation to identify customer needs, constraints and criteria. 5.1.3

4 Develop multiple solutions and select an approach. 5.1.4

2 **Sketching, Drawing, and Visualization: Conceptualize, sketch, and draw design projects and components.** 5.2

1 Compare & contrast technical sketches and drawings. 5.2.1

2 Sketch possible solutions to an existing design problem. 5.2.2

3 Apply annotations on sketches and drawings. 5.2.3

4 Sketch geometric forms and shapes. 5.2.4

Translate abstract thoughts into tangible designs 5.2.5

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. **Material Selection: Select materials for design projects and components.** 5.4

1. Compare advantages of materials used in manufacturing based on physical properties. 5.4.1
2. Identify the production processes used to create products. 5.4.2
3. Determine the appropriate material to be used to create a product considering production process factors and category of material(e.g., organic materials, metals, polymers, ceramics and composites). 5.4.3
4. Evaluate the types and magnitude of stresses and forces. 5.4.4

7. **Blueprint Interpretation: Read, interpret, and utilize blueprints to produce accurate products.** 5.7
   1. Identify and interpret standard symbols used in blueprints. 5.7.1
   2. Demonstrate the ability to read and convert measurements from scaled drawings. 5.7.2
   3. Differentiate between various line types (e.g., solid, dashed) and their meanings in a blueprint. 5.7.3
   4. Analyze and interpret dimensions, tolerances, and annotations effectively. 5.7.4
   5. Utilize reference notes and legends to clarify details and specifications in blueprints. 5.7.5

8. **Schematic Interpretation: Read, interpret, and utilize schematics to produce accurate products.** 5.8
   1. Identify and interpret standard symbols used in schematics. 5.8.1
   2. Recognize and label key components and systems within a schematic 5.8.2
   3. Trace the flow of systems of schematic diagrams. 5.8.3
   4. Utilize reference notes and legends to clarify details and specifications of schematics. 5.8.4
   5. Identify discrepancies or errors in a schematic. 5.8.5

Technical Math and Science: Technical Math and Science: Learners develop a comprehensive understanding of the fundamental principles and applications of technical mathematics and scientific concepts. Learners will perform precise measurements, interpret technical dra sci sol

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1. **Physics of Engineering: Learn the fundamentals of physics as it relates to engineering.** 9.1
   1. Display and interpret numbers in scientific notation and logarithmic scales 9.1.1
   2. Describe and convert SI and US system units of measurement. 9.1.2
   3. Identify and use both metric and inch rules. 9.1.3
   4. Express physical quantities with an appropriate number of significant digits, units and dimensions. 9.1.4
   5. Perform operations on whole numbers, fractions and mixed numbers. 9.1.5
   6. Analyze measurements and perform technical calculations. 9.1.6
   7. Read and interpret charts and tables to analyze data and formulate outcomes. 9.1.7

manufacturing problems. 9

8 Quantitatively describe the units used in pressure measurement, such as Torr, and convert between units. 9.1.8

9 Quantitatively describe the units used in temperature measurement and convert between units (e.g. Fahrenheit, Celsius, Kelvin) 9.1.9

10 Quantitatively describe the units used in density measurement and convert between units (e.g. g/mL, g/cm3, g/L, kg/L, kg/m3) 9.1.10

14 Identify/differentiate engineering drawings. 9.1.14

17 Compare and contrast weight vs mass 9.1.17

18 Explain Newton's three laws of motion and identify their relationship to a specified topic 9.1.18

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4 **Measurement and Interpretation: Interpret drawings and documentation and perform measurements.** 9.4

3 Identify measuring systems and convert between systems. 9.4.3

4 Identify information and symbols provided in drawings and specifications. 9.4.4

5 Skill in taking accurate measurements of material properties, components, and finished products using appropriate measuring tools & equipment. 9.4.5

6 Evaluate the influence environmental factors can have on a part (e.g., temperature). 9.4.6

7 Ability to utilize a variety of different measuring instruments. 9.4.7