Ohio CTE

Construction Technologies

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, resume 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

2 **Leadership and Communication: Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.** 1.2

1 Extract relevant, valid information from materials and cite sources of information. 1.2.1

2 Deliver formal and informal presentations. 1.2.2

3 Identify and use verbal, nonverbal and active listening skills to communicate effectively. 1.2.3

4 Use negotiation and conflict-resolution skills to reach solutions. 1.2.4

5 Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose. 1.2.5

6 Use proper grammar and expression in all aspects of communication. 1.2.6

7 Use problem-solving and consensus-building techniques to draw conclusions and determine next steps. 1.2.7

8 Identify the strengths, weaknesses, and characteristics of leadership styles that influence internal and external workplace relationships. 1.2.8

9 Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity). 1.2.9

10 Use interpersonal skills to provide group leadership, promote collaboration and work in a team. 1.2.10

11 Write professional correspondence, documents, job applications and resumés. 1.2.11

12 Use technical writing skills to complete forms and create reports. 1.2.12

13 Identify stakeholders and solicit their opinions. 1.2.13

14 Use motivational strategies to accomplish goals. 1.2.14

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

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

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

4 Identify how federal and state consumer protection laws affect products and services. 1.3.4

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

6 Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance. 1.3.6

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 [EEOC]). 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

4 **Knowledge Management and Information Technology: Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations.** 1.4

1 Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems). 1.4.1

2 Select and use software applications to locate, record, analyze and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines). 1.4.2

3 Verify compliance with security rules, regulations and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway. 1.4.3

4 Use system hardware to support software applications. 1.4.4

5 Use information technology tools to maintain, secure and monitor business records. 1.4.5

6 Use an electronic database to access and create business and technical information. 1.4.6

7 Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books). 1.4.7

8 Use electronic media to communicate and follow network etiquette guidelines. 1.4.8

5 **Global Environment: Evaluate how beliefs, values, attitudes and behaviors influence organizational strategies and goals.** 1.5

1 Describe how cultural understanding, cultural intelligence skills and continual awareness are interdependent. 1.5.1

2 Describe how cultural intelligence skills influence the overall success and survival of an organization. 1.5.2

3 Use cultural intelligence to interact with individuals from diverse cultural settings. 1.5.3

4 Recognize barriers in cross-cultural relationships and implement behavioral adjustments. 1.5.4

5 Recognize the ways in which bias and discrimination may influence productivity and profitability. 1.5.5

6 Analyze work tasks for understanding and interpretation from a different cultural perspective. 1.5.6

7 Use intercultural communication skills to exchange ideas and create meaning. 1.5.7

8 Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities. 1.5.8

6 **Business Literacy: Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.** 1.6

1 Identify business opportunities. 1.6.1

2 Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk versus reward, reasons for success and failure). 1.6.2

3 Explain the importance of planning your business. 1.6.3

4 Identify types of businesses, ownership and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit). 1.6.4

5 Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments and interdepartmental interactions. 1.6.5

6 Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry. 1.6.6

7. Identify the effect of supply and demand on products and services. 1.6.7

8 Identify the features and benefits that make an organization's product or service competitive. 1.6.8

9 Explain how the performance of an employee, a department and an organization is assessed. 1.6.9

10 Describe the impact of globalization on an enterprise or organization. 1.6.10

11 Describe how all business activities of an organization work within the parameters of a budget. 1.6.11

12 Describe classifications of employee benefits, rights, deductions and compensations. 1.6.12

7 **Entrepreneurship/Entrepreneurs: Analyze the environment in which a business operates and the economic factors and opportunities associated with self-employment.** 1.7

1 Compare and contrast the four types of business ownership (i.e., individual proprietorships, partnerships, corporations, cooperatives). 1.7.1

2 Explain the role of profit as the incentive to entrepreneurs in a market economy. 1.7.2

3 Identify the factors that contribute to the success and failure of entrepreneurial ventures. 1.7.3

4 Assess the roles of nonprofit and for-profit businesses. 1.7.4

5 Develop a business plan. 1.7.5

6 Describe life cycles of an entrepreneurial business and an entrepreneur. 1.7.6

7 Create a list of personal strengths, weaknesses, skills and abilities needed to be successful as an entrepreneur. 1.7.7

8 Explain pathways used to become an entrepreneur. 1.7.8

9 Conduct a self-assessment to determine entrepreneurial potential. 1.7.9

10 Describe techniques for obtaining experience (e.g., apprenticeship, co-operative [co-op] education, work placement, internship, job shadowing) related to an entrepreneurial objective. 1.7.10

11 Identify initial steps in establishing a business (e.g., limited liability company [LLC], tax ID, permits, insurance, licensing). 1.7.11

12 Identify resources available to entrepreneurs (e.g., Small Business Administration, mentors, information resources, educational opportunities). 1.7.12

13 Protect intellectual property and knowledge (e.g., copyright, patent, trademark, trade secrets, processes). 1.7.13

8 **Operations Management: Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.** 1.8

1 Forecast future resources and budgetary needs using financial documents (e.g., balance sheet, demand forecasting, financial ratios). 1.8.1

2 Select and organize resources to develop a product or a service. 1.8.2

3 Analyze the performance of organizational activities and reallocate resources to achieve established goals. 1.8.3

4 Identify alternative actions to take when goals are not met (e.g., changing goals, changing strategies, efficiencies). 1.8.4

5 Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN). 1.8.5

6 Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability. 1.8.6

7 Collect information and feedback to help assess the organization's strategic planning and policymaking processes. 1.8.7

8 Identify routine activities for maintaining business facilities and equipment. 1.8.8

9 Develop a budget that reflects the strategies and goals of the organization. 1.8.9

10 Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability. 1.8.10

9 **Financial Management: Use financial tools, strategies and systems to develop, monitor and control the use of financial resources to ensure personal and business financial well-being.** 1.9

1 Create, analyze and interpret financial documents (e.g., budgets, income statements). 1.9.1

2 Identify tax obligations. 1.9.2

3 Review and summarize savings, investment strategies and purchasing options (e.g., cash, lease, finance, stocks, bonds). 1.9.3

4 Identify credit types and their uses in order to establish credit. 1.9.4

5 Identify ways to avoid or correct debt problems. 1.9.5

6 Explain how credit ratings and the criteria lenders use to evaluate repayment capacity affect access to loans. 1.9.6

7 Review and summarize categories (types) of insurance and identify how insurances can reduce financial risk. 1.9.7

8 Identify income sources and expenditures. 1.9.8

9 Compare and contrast different banking services available through financial institutions. 1.9.9

10 Identify the role of depreciation in tax planning and liability. 1.9.10

10 **Sales and Marketing: Manage pricing, place, promotion, packaging, positioning and public relations to improve quality customer service.** 1.10

1 Identify how the roles of sales, advertising and public relations contribute to a company's brand. 1.10.1

2 Determine the customer's needs and identify solutions. 1.10.2

3 Communicate features, benefits and warranties of a product or service to the customer. 1.10.3

4 Identify the company policies and procedures for initiating product and service improvements. 1.10.4

5 Monitor customer expectations and determine product/services satisfaction by using measurement tools. 1.10.5

6 Discuss the importance of correct pricing to support a product's or service's positioning in the marketing mix. 1.10.6

8 Use promotional techniques to maximize sales revenues (e.g., advertising, sales promotions, publicity, public relations). 1.10.8

7 Describe the importance and diversity of distribution channels (i.e., direct, indirect) to sell a product. 1.10.7

9 Describe how product mix (e.g., product line, product items) maximize sales revenues, market, share and profit margin. 1.10.9

10 Demonstrate sales techniques. 1.10.10

11 **Principles of Business Economics: Examine and employ economic principles, concepts and policies to accomplish organizational goals and objectives.** 1.11

1 Identify the economic principles that guide geographic location of an industry's facilities (e.g., relative scarcity, price, quantity of products and services). 1.11.1

2 Identify the difference between monetary and nonmonetary incentives and explain how changes in incentives cause changes in behavior. 1.11.2

3 Use economic indicators to identify economic trends and conditions (e.g., inflation, interest rate fluctuations, unemployment rates). 1.11.3

4 Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy. 1.11.4

5 Analyze factors that affect currency and exchange rates. 1.11.5

6 Explain how financial markets and government policies influence interest rates (credit ratings/debt ceiling), trade deficits and unemployment. 1.11.6

7 Describe how economic performance and culture are interdependent. 1.11.7

8 Identify the relationships between economy, society and environment that lead to sustainability. 1.11.8

9 Describe how laws and regulations influence domestic and international trade. 1.11.9

12 **Cyber Hygiene: Apply digital information security principles to keep information secure.** 1.12

1 Identify the purpose and practices of Cyber Hygiene. 1.12.1

2 Differentiate between appropriate and inappropriate information. 1.12.2

3 Interpret security policies through job specific training and training updates. 1.12.3

4 Apply secure password behavior. 1.12.4

5 Apply physical and virtual situational awareness (e.g., clean desk policies, shoulder surfing, social engineering, tailgating). 1.12.5

Safety, Tools, and Equipment: Learners apply principles of protection, prevention and mitigation to create and maintain safe working conditions at construction sites. Knowledge and skills may be applied in all aspects of personal site safety to meet all applicable standards. 2

1 **Site Safety: Handle materials, prevent accidents and mitigate hazards.** 2.1

1 Use Occupational Safety and Health Administration (OSHA)-defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling. 2.1.1

2 Identify and rectify or mitigate construction hazards (e.g., thresholds, slippery surfaces, lighting and workplace clutter). 2.1.2

3 Identify and apply load factors for constructing scaffolding, railings, ladders and temporary structures. 2.1.3

4 Apply inspection, rejection criteria, hitch configurations and load-handling practices to slings and rigging hardware. 2.1.4

5 Demonstrate the proper use of American National Standards Institute (ANSI) hand signals. 2.1.5

6 Identify the source of electrical hazards and use shutdown and established lock-out/tag-out procedures. 2.1.6

7 Identify procedures for the handling, storage and disposal of hazardous materials. 2.1.7

8 Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits. 2.1.8

9 Select and operate fire extinguishers based on the class of fire. 2.1.9

10 Create a hazardous materials safety plan (e.g., liquid and airborne materials). 2.1.10

11 Describe the interactions of incompatible substances when measuring and mixing chemicals. 2.1.11

2 **Personal Safety: Practice personal safety in construction.** 2.2

1 Interpret personal safety rights according to the employee Right-to-Know plan. 2.2.1

2 Describe how working under the influence (e.g., drugs, alcohol and stimulants/caffeine) increases the risk of accident, lowers productivity, raises insurance costs, and reduces profits. 2.2.2

3 Select, use, store, maintain and dispose of personal protective equipment (PPE) appropriate to job tasks, conditions and materials. 2.2.3

4 Identify workplace risk factors associated with lifting, operating and moving heavy objects and establish an ergonomics process. 2.2.4

5 Identify, inspect and use safety equipment appropriate for the task. 2.2.5

6 Demonstrate first aid and cardiopulmonary resuscitation (CPR). 2.2.6

7 Identify and describe hazards associated with using electronic devices on the job site. 2.2.7

8 Identify and describe hazards associated with improper clothing and poor hygiene. 2.2.8

9 Describe trenching and excavation hazards (e.g. soil types, cave in, utilities, underground obstacles). 2.2.9

10 Describe the process for identifying and locating existing site utilities. 2.2.10

3 **Equipment Operation: Operate equipment used to move materials, earth and other heavy materials.** 2.3

1 Select the equipment and attachments needed to complete the task. 2.3.1

2 Follow the manufacturers' recommendations for safety, maintenance, limitations and use. 2.3.2

3 Perform pre- and post-operation inspections and adjustments and report malfunctions. 2.3.3

4 Operate levers, pedals or valves to activate power equipment. 2.3.4

5 Drive and maneuver equipment with and without trailers. 2.3.5

4 **Equipment and Machinery Preventative Maintenance: Clean, maintain and perform planned preventative maintenance (PPM) on equipment and machinery.** 2.4

1 Lubricate machinery and equipment. 2.4.1

2 Ensure the presence and functionality of safety systems and hardware. 2.4.2

3 Service electrical systems (e.g., fuses, bulbs). 2.4.3

4 Perform machine adjustments (e.g., belts, drive chains). 2.4.4

5 Service filtration systems. 2.4.5

6 Identify, select and maintain fluid levels. 2.4.6

7 Maintain instrument, machinery and equipment cleanliness, appearance and safety devices. 2.4.7

8 Inspect and maintain fluid conveyance and storage components (e.g., hoses, lines, valves, nozzles). 2.4.8

9 Inspect and maintain tooling and implements. 2.4.9

10 Document and log equipment maintenance records. 2.4.10

Structural Construction: Learners apply principles of architectural engineering to erect residential, commercial and industrial buildings. Knowledge and skills may be applied in constructing footings and foundations; framing floors, walls, ceilings, roofs and stairs; completing exterior and interior finishes; and repairing, restoring or remodeling existing structures. 3

1 **Brick, Block and Concrete: Mix and pour concrete and lay brick and block.** 3.1

1 Complete layout calculations. 3.1.1

2 Set grades and establish benchmark. 3.1.2

3 Construct foundations, footings and retaining walls. 3.1.3

4 Lay brick and block (Concrete Masonry Units) with mortar. 3.1.4

5 Lay out and erect forms and stair forms and install reinforcing material. 3.1.5

6 Lay out and install anchor bolts in concrete. 3.1.6

7 Install and finish mortar joints. 3.1.7

8 Cast and finish concrete. 3.1.8

9 Demonstrate knowledge of specialty finishes to concrete. 3.1.9

10 Level base material. 3.1.10

11 Compare types of foundation and materials (e.g., brick, block, poured). 3.1.11

2 **Site Management: Analyze site management operations.** 3.2

1 Identify topographical and existing features of areas (i.e., property lines, utilities, streets, setbacks) on survey maps (parcel map, survey plat). 3.2.1

2 Interpret features of a site plan. 3.2.2

3 Apply conventional engineering and field measurement processes to survey for site development. 3.2.3

4 Identify and apply relevant building codes. 3.2.4

3 **Excavation: Perform excavation activities from clearing and grubbing to finish grading in accordance with excavation specifications on prints and in local building codes.** 3.3

1 Describe excavation, trenching, and shoring designs. 3.3.1

2 Compare the effects of soil properties, profiles and types on construction and describe fill placement processes (e.g., lifts, geomat fabrics, compaction, density, moisture content). 3.3.2

3 Collect samples and explain the environmental impact of contaminated soil and water on the worksite. 3.3.3

4 Explain disposal procedures for contaminated soil, water and waste. 3.3.4

5 Describe procedures to control water runoff and drainage. 3.3.5

6 Identify the actual location and elevation and determine variance. 3.3.6

7 Check alignment and elevations. 3.3.7

8 Clear and grub land to prepare site for grading. 3.3.8

9 Explain the types of grade (e.g., subgrade, finished grade). 3.3.9

10 Identify the types of stakes and describe their functions. 3.3.10

11 Describe fill materials, their appropriateness and their functions. 3.3.11

12 Lay out stakes in sequence and set grade. 3.3.12

4 **Geographic Information Systems (GIS): Employ GIS computer applications to interpret data, maps and land use.** 3.4

1 Interpret and evaluate the accuracy of digital imagery and aerial photography. 3.4.1

2 Explain map projections and the use of scales. 3.4.2

3 Describe GIS data structures (e.g., vector, grid, triangulated irregular network [TIN]). 3.4.3

4 "Explain digital elevation methods (e.g., digital elevation model [DEM], global positioning system [GPS])." 3.4.4

5 Interpret spatial interpolation and two- and three-dimensional functional spatial analyses. 3.4.5

6 Demonstrate ranging methods. 3.4.6

7 Identify sources of errors in GIS and formulate corrections and solutions. 3.4.7

8 Determine one’s position on the earth using GPS. 3.4.8

9 Integrate GPS data into GIS applications. 3.4.9

5 **Floor Framing: Install floor framing systems.** 3.5

1. Identify, describe, and assemble materials for floor framing. 3.5.1
2. Construct and install sills and sill sealer. 3.5.2
3. Erect girders, beams and columns. 3.5.3
4. Lay out, cut and install floor joists. 3.5.4
5. Frame floor openings. 3.5.5
6. Install bridging (e.g., wood, metal). 3.5.6
7. Install subflooring using adhesives and fasteners. 3.5.7

6 **Wall Framing: Wall and Ceiling Framing** 3.6

1. Identify platform and balloon framing. 3.6.1
2. Lay out walls and rough openings. 3.6.2
3. Compare and contrast metal and wood framing. 3.6.3
4. Locate partitions, determine stud layout and strike wall lines. 3.6.4
5. Describe wall framing techniques used in masonry construction. 3.6.5
6. Cut and assemble wood and metal wall framing components (e.g., corner posts, T-posts, door openings, window openings, headers, cripples, king studs, trimmers, common studs, blocking). 3.6.6
7. Erect and plumb partitions and walls with top and bottom plates. 3.6.7
8. Brace exterior walls and install wind bracing. 3.6.8
9. Install exterior wall sheathing and house wrap. 3.6.9
10. Lay out, cut, and install ceiling joists and bracing. 3.6.10

7 **Roof Framing and Finishing: Construct and finish roof.** 3.7

1. Compare roof types and materials. 3.7.1
2. Identify, describe and assemble materials for roof framing. 3.7.2
3. Lay out, cut and install ridge boards and common rafters. 3.7.3
4. Lay out, cut and install hip rafters and install valley rafters and jack rafters. 3.7.4
5. Lay out, cut and install gable-end studs and lookouts. 3.7.5
6. Frame roof openings, dormers and chimney saddles. 3.7.6
7. Install roof sheathing. 3.7.7
8. Install prefabricated roof trusses with required hardware. 3.7.8
9. Install drip edges, eaves flashing and roof vents. 3.7.9
10. Install underlayment (ice and water barriers) and shingles. 3.7.10
11. Lay out and install shingles and other roof finishes (e.g., fiberglass, asphalt, wood, valley material, felt paper, starter strip, hip and ridge caps). 3.7.11

8 **Exterior Finish Work: Complete exterior finish.** 3.8

1 Compare types and characteristics of doors and windows. 3.8.1

2 Identify, describe, and assemble materials for exterior finishing. 3.8.2

3 Install exterior door and window units and hardware. 3.8.3

4 Install weather stripping and apply caulking and sealant. 3.8.4

5 Install fascia and soffits with backing. 3.8.5

6 Cut and install molding and frieze board. 3.8.6

7. Case exterior openings. 3.8.7

8 Install exterior siding, covering, or finishes. 3.8.8

9 Install exterior trim accessories (e.g., gutters, downspouts, louvers, shutters, posts, railings, decorative moldings). 3.8.9

10 Install draft stopping. 3.8.10

9 **Stairs: Construct stairs.** 3.9

1 Describe stairway types and their components. 3.9.1

2 Calculate rise and run and design stairway risers, treads, carriage, stringers and clearances. 3.9.2

3 Lay out, cut, and install stair components. 3.9.3

4 Install stair finish trim components (e.g., skirt boards, handrails, balusters, newels, volutes, balustrade systems). 3.9.4

5 Install prefabricated stairs and drop-down stair units (e.g., attic stairs). 3.9.6

10 **Interior Finish Work: Complete interior finish for residential, industrial and commercial facilities.** 3.10

1 Describe the different types and characteristics of drywall and finishing materials. 3.10.1

2 Lay out the drywall installation and nail or screw pattern and install drywall and corner accessories. 3.10.2

3 Describe the effects insulation, vapor barriers and ventilation can have on controlling moisture. 3.10.3

4 Install insulation and vapor barriers for wall and ceiling finishes. 3.10.4

5 Install drywall board. 3.10.5

6 Finish drywall board. 3.10.6

7 Lay out and install alternative methods of ceiling (e.g. acoustic, suspended). 3.10.7

8 Prepare subfloor, install building paper and cut and install underlayment. 3.10.8

9 Lay out and install finished flooring (e.g., vinyl, carpet, wood, ceramic). 3.10.9

10 Install door units (e.g., prehung, double hung, folding, sliding) and door hardware. 3.10.10

11 Install interior door and window trim (e.g., stools, sills, jamb extensions, casing, mullions, aprons). 3.10.11

12 Apply finish coatings (e.g., paint, stains, varnishes, texturing, wallpaper). 3.10.12

13 Install baseboard and moldings (e.g., standard, crown, built-up moldings). 3.10.13

14 Install cabinetry, shelving and related hardware. 3.10.14

11 **Remodeling: Repair, restore, or remodel existing structures.** 3.11

1 Identify customer needs and develop a plan for a remodeling or restoration project. 3.11.1

2 Identify damage, diagnose cause of damage and plan repair. 3.11.2

3 Diagnose problems and plan deconstruction and preparation for repairs and/or restoration. 3.11.3

4 Integrate new construction into existing structure. 3.11.4

5 Match materials selected to the original structure. 3.11.5

6 Design and construct temporary bracing and shoring and install safety and security devices during construction. 3.11.6

Electrical: Learners apply principles of electricity and knowledge of building codes to construct systems to generate and deliver power in residential, commercial and industrial applications. Knowledge and skill may be applied to rough-in and finish wiring, motors and power wiring, specialized low-voltage systems, alternative power systems, power transmission, plant operations and coal equipment. 4

1 **Electrical Theory: Summarize electrical principles and theories** 4.1

1. Describe atomic structure and its relationship to electricity. 4.1.1
2. Compare the relationship between electrical and electromagnetic effect. 4.1.2
3. Identify methods of producing electrical current. 4.1.3
4. Describe the differences between alternating current (AC) and direct current (DC). 4.1.4
5. Compare conductors and insulators. 4.1.5
6. Describe the relationships between voltage, current, resistance and power in circuits. 4.1.6
7. Calculate voltage, current, resistance, impedance and power in circuits using Ohm's Law, Kirchhoff's Law and Watt's Law. 4.1.7

2 **Circuits: Analyze and evaluate direct current (DC) circuits and alternating current (AC) circuits.** 4.2

1. Identify electrical, electromechanical and solid state controls. 4.2.1
2. Describe the purpose of and common methods used for grounding and bonding. 4.2.2
3. Analyze wiring schematics and diagrams to troubleshoot circuits. 4.2.3
4. Explain the uses of series, parallel and series-parallel circuits. 4.2.4
5. Construct and test series, parallel and series-parallel circuits. 4.2.5
6. Determine voltage, current, frequency and phase. 4.2.6
7. Identify common types and uses of transformers. 4.2.7
8. Calculate service load demands and branch circuit load demands 4.2.8
9. Identify types of capacitors and common usages for each. 4.2.9
10. Identify methods of varying capacitance. 4.2.10
11. Identify types of inductors and explain the purposes of different core materials. 4.2.11
12. Identify the characteristics of inductors and capacitors in series and parallel circuits. 4.2.12
13. Calculate true power, apparent power, reactive power and power factor. 4.2.13

3 **Codes and Regulations: Explain and apply the National Electrical Code (NEC) and other building codes.** 4.3

1 Describe the role of Nationally Recognized Testing Laboratories (e.g. Underwriters Laboratory (UL), Canadian Standards Association (CSA) and Intertek Testing Service/Edison Testing Laboratory (ITS/ETL)). 4.3.1

2 Locate and apply the information in articles of the NEC and other relevant codes and explain how they impact job requirements (e.g., service conductors, feeders, branch circuits, overload protection, grounding and bonding requirements, low voltage). 4.3.2

3 Utilize National Fire Protection Association (NFPA) procedures for NFPA 70E-arc flash boundaries, current-limiting fuses, live work power permits, electrically safe work conditions, emergency worker safety programs, scheduling, energized circuits and training. 4.3.3

4 **Electrical Wiring: Install above and in-ground wiring in residential, commercial, and industrial settings.** 4.4

1 Select materials and lay out rough-in wiring runs according to specifications, drawings and code requirements. 4.4.1

2 Identify and install fasteners, anchors, and fire stop systems. 4.4.2

3 Locate and mount electrical boxes in exterior and interior applications. 4.4.3

4 Verify the location of and install service entrance systems. 4.4.4

5 Install service panels, meter apparatus, grounding electrode systems, subpanels and over current protective devices. 4.4.5

6 Identify and label a panel directory to reflect devices and circuits installed on each circuit. 4.4.6

7 Lay out and install conduit or cable runs, raceways and cable systems (e.g., electrical metallic tubing [EMT], galvanized rigid conduit [GRC], intermediate metal conduit [IMC], polyvinyl chloride [PVC], electrical nonmetallic tubing [ENT or ENMT], armored cable [AC], metal clad cable [MC]). 4.4.7

8 Install rough-in wiring following specifications, drawings and code requirements. 4.4.8

9 Install, service, and troubleshoot low-voltage systems (e.g., communication systems, telephone systems, control systems, lighting systems, security systems, fire alarm systems). 4.4.9

10 Install lighting fixtures, wiring devices and covers. 4.4.10

11 Install equipment grounding and bonding systems. 4.4.11

12 Make conductor terminations. 4.4.12

13 Connect electrical appliances and equipment in accordance with NEC and manufacturers instructions. 4.4.13

14 Check and test installation. 4.4.14

5 **Motors and Power: Install motors and power wiring in accordance with the National Electrical Code (NEC).** 4.5

1 Identify types and components of single-phase, split-phase and three-phase motors. 4.5.1

2 Calculate the branch circuit size of the motor based on nameplate information and specifications. 4.5.2

3 Determine motor rotation needed for the installed load and explain the process for reversing rotation (i.e., three-phase, single-phase). 4.5.3

4 Interpret schematics and control diagrams for building a motor circuit. 4.5.4

5 Wire single-phase, split-phase and three-phase circuits and install motor control devices (i.e., contactors, starters, variable frequency and motor speed controls). 4.5.5

6 Explain the starting sequence of motor components within a given circuit. 4.5.6

7 Troubleshoot and repair motor and starting systems to verify operation according to schematics and control diagrams. 4.5.7

8 Describe how programmable controllers can be used in single-phase, split-phase and three-phase circuits. 4.5.8

6 **Alternative Power and Renewable Energy Systems: Describe specialized power systems and components.** 4.6

1 Compare renewable energy systems. 4.6.1

2 Identify and describe the functions of standby power systems (i.e., generator, uninterrupted power supplies [UPS] systems). 4.6.2

3 Identify and describe the functions of electric storage systems. 4.6.3

4 Describe battery maintenance functions (e.g., cleaning, checking electrolyte quality and level and battery status) and disposal methods. 4.6.4

Environmental Systems and Plumbing: Learners apply principles of physics and thermodynamics to install and maintain heating, ventilation and air conditioning (HVAC) and plumbing systems in residential, commercial, industrial, and utility applications. 5

1. **Refrigeration: Apply physical principles of refrigeration to the installation and maintenance of heating, ventilation and air conditioning (HVAC) systems.** 5.1
    1. Record, analyze, and interpret temperature and pressure measurements and their relationship. 5.1.1
    2. Describe heat, heat transfer, energy and energy conversion. 5.1.2
    3. Differentiate between sensible, latent and total heat. 5.1.3
    4. Describe the thermodynamic cycle in the refrigeration process. 5.1.4
    5. Compare the functions of evaporators, condensers, compressors and metering devices of the basic refrigeration cycle. 5.1.5
    6. Compare the characteristics of refrigerants. 5.1.6
    7. Describe, calculate, and record superheating and subcooling. 5.1.7
    8. Calculate and record the saturation temperature of a refrigerant. 5.1.8
    9. Measure, calculate and set airflow (e.g., Cubic Feet per Minute and British Thermal Unit (BTU)). 5.1.9

2. **Heating, Ventilation, Air Conditioning/Refrigeration (HVAC/R) Systems Installation: Install refrigeration, air conditioning, and heating systems.** 5.2
    1. Identify the basic components of a self-contained air conditioning unit. 5.2.1
    2. Identify and install a central air conditioning system. 5.2.2
    3. Identify and install an air-to-air heat pump. 5.2.3
    4. Identify and install a refrigeration condensing unit with a remote evaporator. 5.2.4
    5. Identify and explain the installation of natural gas, propane gas, electric and oil heating units. 5.2.5
    6. Identify and install natural gas, propane gas, electric and oil heating units. 5.2.6
    7. Identify the components of a geothermal system. 5.2.7

3. **Service Maintenance: Perform service maintenance (SM) and repair on environmental controls technology equipment (e.g., electric heating equipment, air handler, air filtration equipment, humidifier/dehumidifier, air conditioner, heat pump).** 5.3
    1. Perform routine cleaning and inspection of system and components. 5.3.1
    2. Inspect and replace filters, belts and fluids. 5.3.2
    3. Recover, recharge and reclaim refrigerant from refrigeration and air conditioning equipment according to Environmental Protection Agency (EPA) regulations. 5.3.3
    4. Troubleshoot and service refrigeration and air conditioning equipment. 5.3.4
    5. Troubleshoot and service heating systems. 5.3.5

4 **Energy Assessment: Implement principles and guidelines needed to carry out effective energy assessments in accordance with the Building Energy Efficiency Ordinance.** 5.4

1 Identify the requirements of an energy assessment. 5.4.1

2 Collect data (e.g., measure square footage, window size, sun load, number of occupants, insulation R-value) and perform load calculation to select equipment 5.4.2

3 Calculate the energy and cost savings due to improvement in electrical, mechanical and plumbing systems performance and power quality. 5.4.

5 **Boiler Systems: Describe and monitor the operation of hydronic and steam boiler systems.** 5.5

1 Compare the uses and components of hydronic and steam boiler systems. 5.5.1

2 Observe and test system operations and safety controls. 5.5.2

3 Perform service maintenance and repair procedures for hydronic and steam boiler systems. 5.5.3

6 **Sheet Metal: Fabricate and install ductwork systems.** 5.6

1 Identify the components of a duct system. 5.6.1

2 Select materials to fabricate ductwork based on job specifications. 5.6.2

3 Lay out, cut and shear ductwork and fittings. 5.6.3

4 Bend, fold, form and assemble a ductwork system. 5.6.4

5 Seal and insulate ductwork. 5.6.5

6 Fasten and hang ductwork. 5.6.6

7 Install cleats and drives in ductwork. 5.6.7

8 Describe the impact of modifying structural members of duct work without weakening the structure. 5.6.8

9 Take field measurements and translate them to sketch for shop fabrication 5.6.9

7 **Drainage: Rough in drainage systems following plumbing codes and standards in interior and exterior applications.** 5.7

1 Locate drainage system entry points, walls, and chases. 5.7.1

2 Identify components of a drainage system and describe their functions. 5.7.2

3 Describe how waste moves from a fixture through the drain system to the environment. 5.7.3

4 Describe factors that are considered when planning and installing a wastewater drainage system. 5.7.4

5 Estimate and compute length, angle of measurement, area, surface area and volume to calculate pipe legs and pipe sizes. 5.7.5

6 Calculate the slope required for drainage components. 5.7.6

7 Select drainage components based on their application for a given purpose. 5.7.7

8 Describe the impact of modifying structural members for drainage lines without weakening the structure. 5.7.8

9 Identify and explain the installation of pipe sleeves or thimbles through walls, ceilings or floors. 5.7.9

10 Join pipe, pipefittings and valves of similar and dissimilar materials using solvents and mechanical means of joining. 5.7.10

11 Identify and explain the installation of plumbing fixtures and appliances to a drain system. 5.7.11

12 Test the drainage system for leaks. 5.7.12

13 Locate cleanout access points and clear obstructions from lavatories, water closets and sinks. 5.7.13

14 Describe the design, basic operation and care of a septic system. 5.7.14

15 Determine the location and type of sewer drainpipes and storm drains. 5.7.15

16 Identify and explain the installation of sewer drainpipes, septic tanks and storm drains. 5.7.16

8 **Water Systems: Rough in water systems following plumbing codes and standards, in interior and exterior applications.** 5.8

1 Compare and contrast sources of contamination in water supplies and methods of disinfecting water. 5.8.1

2 Explain the types and applications of pumps and pump controls used in water supplies. 5.8.2

3 Prevent freezing and mechanical damage to pipes. 5.8.3

4 Describe how water moves from the source through the water distribution system to the fixture. 5.8.4

5 Describe ways in which a water supply system can become contaminated and prepare a water sample for analysis by a testing laboratory. 5.8.5

6 Describe factors to consider when planning and installing a water distribution system. 5.8.6

7 Estimate and compute length, angle of measurement, area, surface area and volume to calculate pipe legs and pipe sizes. 5.8.7

8 Locate water supply system entry points, walls and chases. 5.8.8

9 Describe the function of the pipe, pipefittings, valves and fixtures that comprise a water supply system. 5.8.9

10 Select water supply components based on their application for a given purpose. 5.8.10

11 Explain the impact of modifying structural members for water supply lines without weakening the structure. 5.8.11

12 Join water supply pipe, pipefittings and valves of similar and dissimilar materials using solder, brazing, solvents and mechanical means of joining. 5.8.12

13 Connect water supply to plumbing fixtures and appliances. 5.8.13

14 Test a water supply system for leaks and pressure using soap, inert gas, electronic sensors and fluorescent dye. 5.8.14

15 Perform maintenance on water supply components of plumbing fixtures and appliances. 5.8.15

9 **Fuel Piping Systems: Construct fuel piping systems following codes and standards for interior and exterior applications.** 5.9

1 Identify the types of fuel systems and describe the advantages and disadvantages of each. 5.9.1

2 Describe the physical properties and potential hazards associated with different fuel types. 5.9.2

3 Describe the pipe, fittings, and valves used in fuel piping systems and describe their functions. 5.9.3

4 Join pipe, fittings, and valves used in a piping system that transfers fuel. 5.9.4

5 Connect appliances and equipment to fuel piping systems. 5.9.5

6 Describe fuel piping testing methods and perform leak tests. 5.9.6

Construction Management and Jobsite Maintenance: Learners apply principles of business, facility and site operations and project management to build and operate residential, commercial and industrial facilities. Knowledge and skill may be applied in managing and supervising site operations; developing work sequences for tasks and units of work; coordinating material and equipment delivery; planning building stages and the build environment; and providing facility management, and maintenance services. 6

1 **Construction Math: Apply math and measurement principles to complete construction projects.** 6.1

1 Calculate surface area and volume for three-dimensional objects, accurate to a specified level of precision. 6.1.1

2 Apply measurement scales to layout length, width, and angle measurements. 6.1.2

3 Apply algebraic procedures and geometric concepts to reading construction documents. 6.1.3

4 Use proportional reasoning and apply indirect measurement techniques (e.g., right triangle trigonometry, properties of similar triangles). 6.1.4

5 Select and use measurement tools (i.e. grade rod, ruler, tape measure, measuring cups, builder's level). 6.1.5

6 Perform calculations and conversions with fractions, decimals, and percents. 6.1.6

7 Perform unit conversions. 6.1.7

2 **Construction Drawings: Read and interpret plans and diagrams within a construction drawing set (i.e., topographical, grading and drainage, architectural, structural, plumbing, mechanical, electrical) to organize a project work sequence.** 6.2

1 Collect and analyze project information to determine resources and tasks required to complete a project. 6.2.1

2 Read and interpret a site plan. 6.2.2

3 Use architect's and engineer's scales to read and interpret construction drawings for material calculations and installation at the jobsite. 6.2.3

4 Read, interpret, and organize construction drawings, models, specifications and other contractual documents. 6.2.4

5 Describe various building sections, wall sections and other architectural details of residential, commercial, utility, and highway construction. 6.2.5

6 Identify and interpret aspects of sustainable design and construction techniques in construction drawings and specifications. 6.2.6

7 Identify and interpret aspects of the Americans with Disabilities Act (ADA) in construction drawings and specifications. 6.2.7

8 Read and interpret various 3-D and other Computer Aided Design (CAD) generated views in construction drawings. 6.2.8

9 Read and interpret various Building Information Modeling (BIM) generated views in construction drawings. 6.2.9

3 **Construction Estimating: Develop an estimate of material, time, personnel, and equipment needs, availability, and cost for various construction types.** 6.3

1 Complete a site inventory and analysis, including the physical conditions, code, and utilities requirements and the environmental impact. 6.3.1

2 Identify necessary material, time, personnel, and equipment to be used in construction projects. 6.3.2

3 Calculate cost of identified materials, time, personnel and equipment to be used in construction projects. 6.3.3

4 Develop a program list including intended use, budget, economics, customer wants and needs, and maintenance. 6.3.4

4 **Construction Scheduling: Organize material and equipment delivery to maximize productivity.** 6.4

1 Describe the schedule of labor, delivery of materials/equipment and the effect on employer cash flow and construction economics. 6.4.1

2 Prescribe material and equipment storage needs and location on different types of job sites (e.g., access, delivery, protection from the elements, security). 6.4.2

3 Create a schedule of construction and installation. 6.4.3

4 Prepare and process unused material inventory for return credit. 6.4.4

5 **Field Organization: Summarize the sequence of building stages, systems quality control, and inspection processes within a build environment.** 6.5

1 Identify the Critical Path Method (CPM) to select and sequence the appropriate building stages and explain their relationships in completing a construction project. 6.5.1

2 Identify the various material testing techniques (e.g., hardness, tensile strength, bearing capacity, wear resistance, and soil tests). 6.5.2

3 Describe the steps to commissioning and/or recommissioning process for a facility and its mechanical equipment. 6.5.3

4 Describe the process to a walkthrough and creation of a punchlist to ensure conformity with plans, specifications and authorized change orders. 6.5.4

5 Identify a final inspections order to obtain certificate of occupancy. 6.5.5

6 Describe the sustainable building evaluation and certification process. 6.5.6

7 Identify the roles and goals of construction professionals within a given delivery system (e.g., owners, architects, engineers, suppliers, general and trade contractors, consultants, regulators). 6.5.7

6 **Building Maintenance: Provide maintenance, repair and renovations to maintain the long-term conservation and protection of facility buildings and grounds.** 6.6

1 Identify types of surface material (porous/nonporous) to determine processes and chemicals needed to clean and maintain floors using manufacturers' recommendations. 6.6.1

2 Identify type of carpet (e.g., fibers, styles, construction methods) and associated processes and procedures used for cleaning. 6.6.2

3 Perform interim maintenance used in extending the life of the floor surfaces and coverings. 6.6.3

4 Identify hard, resilient, and wood floor coverings and use procedures (e.g., scrubbing, stripping, buffing, high-speed burnishing, screening, sealing), chemicals and equipment needed to maintain and extend the life of the flooring. 6.6.4

5 Describe sustainable, healthy, and high-performance cleaning. 6.6.5

6 Develop and implement a custodial care plan (i.e., custodial duties and frequency; routine, renovation, supervisory, management activities) that provides a safe and healthy environment for a facility and analyzes efficiency based on hours and square footage. 6.6.6

7 Select procedures and processes needed to clean, disinfect and maintain wall surfaces (e.g., painted, tiled, papered, plastered). 6.6.7

8 Clean and disinfect lavatories and kitchen in accordance with health and safety guidelines. 6.6.8

9 Replenish consumable supplies and maintain levels of inventory. 6.6.9

10 Collect and dispose solid and hazardous waste in accordance with local codes and green initiatives. 6.6.10

11 Develop a green cleaning program that identifies cleaning procedures, services, equipment, and supplies that provide improvements in ergonomics and reduce the effect on human health without harming the environment. 6.6.11

12 Schedule preventative maintenance, repair, and renovation to maintain a safe and healthy environment using computer-aided facilities management programs as appropriate. 6.6.12

13 Develop and implement a waste management and recycling plan that reduces costs based on local codes and regulations. 6.6.13

14 Develop and implement an integrated pest management plan that reduces environmental impact and reduces cost. 6.6.14

15 Identify the need for a water and energy conservation and management plan. 6.6.15

16 Compare and contrast green and traditional practices in the selection of materials, chemicals and equipment. 6.6.16

Planning and Design: Learners apply principles of architectural and civil engineering, drawing and construction with current technology to develop, present and use construction proposals, plans and schematics. Knowledge and skill may be applied throughout the project from preconstruction design through all stages of building in residential, commercial and industrial applications. 7

1 **Proposals: Develop and present a design, proposal, or concept.** 7.1

1 Differentiate between residential, commercial, industrial, infrastructure, and institutional construction segments. 7.1.1

2 Collect and analyze data to identify required deliverables (e.g., reports, studies, building designs, drawings) based on client specifications. 7.1.2

3 Conceptualize design through hand drawing. 7.1.3

4 Create a visualization of a proposed project using data from relevant materials according to client specifications and in compliance with building codes. 7.1.4

5 Incorporate building structural systems, environmental systems, safety systems, building envelope systems and building service systems into the design. 7.1.5

6 Incorporate sustainable design and construction techniques. 7.1.6

7 Incorporate the Americans with Disabilities Act (ADA) Standards for Accessible Design. 7.1.7

8 Develop and present the comprehensive proposal. 7.1.8

2 **Community Planning: Compare and contrast construction planning in urban and rural areas.** 7.2

1 Identify components necessary to managing municipal functions. 7.2.1

2 Describe the roles of city governments in community planning. 7.2.2

3 Examine problems of mass movement and spatial reorganization generated by expanding populations. 7.2.3

4 Identify implementation tools for orderly, efficient and equitable development and arrangement of land (i.e., zoning, development regulations, capital improvement programs). 7.2.4

5 Discuss appropriate health and social programs to improve the standard of living for those lacking in resources and/or opportunities. 7.2.5

6 Examine the preservation of historic buildings, neighborhoods and sites to implement a cultural appreciation of architecture and geographic heritage through the protection of the physical representations of that heritage. 7.2.6

7 Compare the community goals and objectives to the coordination of the transportation network. 7.2.7

8 Analyze housing problems and opportunities. 7.2.8

9 Identify economic development resources (e.g., policy development) for attracting and retaining industries. 7.2.9

10 Integrate environmental values (e.g., preservation of wetlands, air quality strategies, protection of natural areas) into land use and other community plans. 7.2.10

11 Merge the harmonious design (e.g., culture, related buildings and areas, aesthetics) of urban areas with urban policy. 7.2.11

12 Examine the strategies for regional and national development (i.e., modernization and urbanization, transportation, rural development patterns, sustainable development, related strategies of economic development). 7.2.12

13 Examine the economic factors that determine whether and where development, restoration and other investments occur. 7.2.13

3 **Drafting: Design residential, industrial, civil and commercial plans in accordance with the current American Institute of Architects (AIA) Architectural Graphic Standards.** 7.3

1 Construct site plans in accordance with the current American Institute of Architects (AIA) Architectural Graphic Standards, (e.g., zoning, property lines, utilities, building line, setback). 7.3.1

2 Construct scaled orthographic drawings to illustrate floor plans with appropriate adjacencies, traffic patterns, orientation of spaces and section views (e.g., stairway section, wall, cabinet elevations, building corners, elevation) in accordance with the current American Institute of Architects (AIA) Architectural Graphic Standards. 7.3.2

3 Construct foundation and roof plans in accordance with the current American Institute of Architects (AIA) Architectural Graphic Standards. 7.3.3

4 Construct mechanical, electrical, infrastructure, and plumbing plans and schematics in accordance with the current American Institute of Architects (AIA) Architectural Graphic Standards. 7.3.4

5 Incorporate public spaces and cultural aesthetics in commercial structures. 7.3.5

6 Identify the role of Computer Aided Design (CAD) and Building Information Modeling (BIM) in Construction drafting. 7.3.6

7 Identify the parties involved and the roles each play in the Building Information Modeling (BIM) process from conceptual design through construction completion and into facility management. 7.3.7

8 Describe the Building Information Modeling (BIM) process from conceptual design through construction completion and into facility management. 7.3.8