Texas CTE

Architecture and Construction (2010): Grade 12

Adopted 2010

Principles of Architecture and Construction

(1) The student performs mathematical operations to complete tasks such as estimating materials and supplies. The student is expected to:

(A) use appropriate geometric formulas and calculations to determine areas and volumes of various structures and estimate materials and supplies;

(B) use appropriate formulas and calculations to determine percentages and decimals and use percentages and decimals to perform measurement tasks;

(C) use appropriate formulas and calculations to determine ratios, fractions, and proportion measures and use ratios, fractions, and proportion measures to perform measurement tasks; and

(D) use dimensions, spaces, and structures calculations to estimate materials and supplies.

(2) The student performs physics skills to work with materials and load applications. The student is expected to:

(A) apply basic concepts of static and loads to planning; and

(B) identify the physical properties present when using common construction materials in order to use the materials safely, effectively, and efficiently.

(3) The student manages chemical materials safely. The student is expected to:

(A) recognize the issues present when mixing compatible and incompatible substances to maintain workplace and job site safety;

(B) differentiate between incompatible and compatible substances;

(C) prevent the mixing of incompatible substances;

(D) describe the chemical process that occurs when using common construction materials to maintain workplace and job site safety;

(E) apply chemical processes in relation to environmental conditions; and

(F) apply chemical processes in relation to construction building materials.

(4) The student reads, understands, and responds to English language technical documents to effectively accomplish assignments. The student is expected to:

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(A) read, interpret, and use technical and workplace documents to accomplish workplace and job site assignments;

(B) read and understand industry-specific terminology;

(C) interpret workplace documents;

(D) use verbal or written processes to report key information;

(E) use technology to transmit reports;

(F) use written communications such as written estimates, work orders, and memos; and

(G) read and follow technical instructions and manuals.

(5) The student writes clear and effective English to prepare information. The student is expected to:

(A) complete reports and documents to comply with project requirements;

(B) compose an accurate and organized diary or log of work;

(C) write reports and documents such as estimates, permits, memos, and technical reports; and

(D) write reports and work orders that meet industry standards.

(6) The student uses industry-specific verbal and visual skills to accomplish effective communications. The student is expected to:

(A) match verbal and visual communications to industry-specific situations; and

(B) use correct terminology to convey verbal and visual communications.

(7) The student listens attentively and speaks clearly to convey information correctly. The student is expected to:

(A) confirm understanding of verbal and visual instructions;

(B) ask relevant questions concerning details of instructions; and

(C) perform assignments as requested.

(8) The student listens to and speaks with a variety of individuals to enhance communications skills. The student is expected to:

(A) speak succinctly and clearly to convey information;

(B) speak so that others can understand and carry out information presented;

(C) provide verbal instructions; and

(D) listen attentively to spoken messages to respond to information.

(9) The student exhibits public-relations skills to address a variety of situations such as increasing internal and external customer and client satisfaction. The student is expected to:

(A) communicate effectively to develop positive customer and client relationships;

(B) develop and maintain customer relations;

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(C) apply relationship skills in a variety of situations;

(D) define customer and client satisfaction; and

(E) evaluate customer and client satisfaction.

(10) The student identifies the relationship between available resources and requirements of a problem to accomplish realistic planning. The student is expected to:

(A) estimate resources and materials required for a specific problem, including time-management, labor-management, job-management, and job-site obligations in order to effectively plan;

(B) estimate correct amount of required resources and materials;

(C) evaluate feasibility of alternative suggestions;

(D) implement appropriate alternatives;

(E) use available resources and materials effectively to complete a project or resolve a problem;

(F) evaluate waste of resources and materials;

(G) evaluate necessity for additional resources and materials;

(H) determine alternative solutions for a specific problem in order to effectively plan;

(I) evaluate feasibility of alternative suggestions; and

(J) implement appropriate alternatives.

(11) The student evaluates and adjusts plans and schedules to respond to unexpected events and conditions. The student is expected to:

(A) incorporate potential job disruptions into planning timelines;

(B) identify potential events and conditions that disrupt the completion of a job;

(C) solve situational problems involved with unexpected events and conditions;

(D) adjust plans and schedules to meet project needs;

(E) modify existing plans to reflect an unexpected change;

(F) modify existing schedules to reflect an unexpected change;

(G) identify and assess critical situations as they arise to resolve issues;

(H) evaluate potential solutions and determine the best solution;

(I) appraise critical situations and implement appropriate responses;

(J) provide a project update to track changes necessitated by unexpected events and conditions; and

(K) present verbal or written status reports on the project.

(12) The student synthesizes and reports conditions to keep the organization appraised of progress and potential problems. The student is expected to:

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(A) provide a project update to keep stakeholders up to date; and

(B) present a verbal or written status report on the project.

(13) The student uses technology tools specific to architecture and construction to access, manage, integrate, and create information. The student is expected to:

(A) manage personal schedule and contact information;

(B) create a tasks list;

(C) manage daily, weekly, and monthly schedules using an application;

(D) manage personal and professional contact information;

(E) create memos and notes;

(F) create personal reminders;

(G) create and send notes, informal memos, and reminders using applications; and

(H) use electronic mail applications.

(14) The student uses email to communicate within and across organizations. The student is expected to:

(A) access an email system using login and password functions;

(B) access email messages received;

(C) create email messages in accordance with established business standards such as grammar, word usage, spelling, sentence structure, clarity, and etiquette;

(D) practice email etiquette;

(E) send email messages;

(F) use email to share files and documents;

(G) access email attachments;

(H) attach documents to messages;

(I) save email messages and attachments; and

(J) practice contamination protection strategies for email.

(15) The student uses Internet applications. The student is expected to:

(A) search for information and resources;

(B) select appropriate search engines;

(C) select appropriate search procedures and approaches;

(D) locate information using search engines and Boolean logic;

(E) navigate websites using software functions;

(F) access and evaluate Internet resources;

(G) access business and technical information using the Internet;

(H) access commercial, government, and education resources; and

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(I) evaluate Internet resources for accuracy of information.

(16) The student uses writing and publishing applications. The student is expected to:

(A) prepare simple documents and other business communications;

(B) retrieve existing documents;

(C) create documents such as letters, memos, and reports using existing forms and templates;

(D) safeguard documents using name and save functions;

(E) format text using basic formatting functions; and

(F) employ word processing utility tools such as spell check, grammar check, and thesaurus.

(17) The student uses spreadsheet applications. The student is expected to:

(A) create, retrieve, edit, save, and print spreadsheets;

(B) perform calculations and analysis on data;

(C) group worksheets;

(D) create charts and graphs from a spreadsheet;

(E) perform calculations using simple formulas; and

(F) input and process data using spreadsheet functions.

(18) The student uses database applications. The student is expected to:

(A) manipulate data elements;

(B) enter data using a form;

(C) locate and replace data using search and replace functions; and

(D) process data using database functions such as structure, format, attributes, and relationships.

(19) The student uses collaborative applications. The student is expected to:

(A) facilitate group work through management of shared schedule and contact information;

(B) manage daily, weekly, and monthly schedules using an application; and

(C) maintain a shared database of contact information.

(20) The student uses computer operations applications. The student is expected to:

(A) manage computer operations;

(B) apply basic commands of operating system software;

(C) employ desktop operating skills;

(D) manage file storage;

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(E) apply appropriate file and disk management techniques;

(F) differentiate between files and directories;

(G) determine file organization; and

(H) use system utilities for file management.

(21) The student uses computer-based equipment containing embedded computers or processors used to control electromechanical devices. The student is expected to:

(A) operate computer-driven equipment and machines;

(B) secure needed supplies and resources;

(C) follow power-up and log-on procedures;

(D) respond to system messages using a console device;

(E) run applications in accordance with processing procedures;

(F) follow log-off and power-down procedures;

(G) use installation and operation manuals;

(H) access needed information using appropriate reference materials;

(I) troubleshoot computer-driven equipment and machines and access support as needed;

(J) test a system using diagnostic tools and software;

(K) repair or replace malfunctioning hardware;

(L) reinstall software as needed;

(M) recover data files; and

(N) restore system to normal operating standards.

(22) The student complies with governmental regulations and applicable codes to establish a legal and safe environment. The student is expected to:

(A) identify occupation-specific governmental regulations and national, state, and local building codes to establish appropriate regulations and codes;

(B) follow governmental regulations and building codes;

(C) use information given in regulations and codes correctly;

(D) pass job inspections and comply with regulations at all times;

(E) monitor activities to comply with governmental and other applicable safety regulations such as the Environmental Protection Agency and Occupational Safety and Health Administration;

(F) read and discuss information on Occupational Safety and Health Administration, Environmental Protection Agency, and other safety regulations;

(G) pass safety inspections and comply with regulations at all times;

(H) use Material Safety Data Sheet information to manage and dispose of hazardous materials;

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(I) identify environmental hazards to promote safety; and

(J) follow safe practices relating to environmental hazards.

(23) The student examines the roles and responsibilities of technicians and professionals to complete a project. The student is expected to:

(A) plan, organize, schedule, and manage a project or job to optimize workflow sequence;

(B) report results of the project or job;

(C) use time-management skills to schedule a project or job;

(D) identify a timeline required to complete a project or job;

(E) evaluate efficiency and effectiveness of a project or job;

(F) recognize relationships between technicians and professionals to facilitate smooth workflow;

(G) coordinate work between various occupations;

(H) incorporate job functions in the reporting chain of supervision; and

(I) evaluate the safety issues and responsibilities managed by each level of supervision.

(24) The student examines all aspects of the built environment and systems to complete project planning. The student is expected to:

(A) align and incorporate the built environment and its systems to complete the project;

(B) label all systems on a set of construction documents;

(C) discuss the interrelationship of the systems in the built environment; and

(D) use a sequential method such as the critical path method so that work progresses efficiently.

(25) The student applies industry standards and practices to ensure quality work. The student is expected to:

(A) identify current industry standards and practices in order to incorporate quality into projects;

(B) document how quality improves profitability;

(C) report on issues that affect quality;

(D) use industry standards and practices to enhance appreciation for quality workmanship; and

(E) perform work that meets or exceeds the quality standards of the industry.

(26) The student observes rules and regulations to comply with personal and occupational health and safety standards. The student is expected to:

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(A) align appropriate safety standards to ensure a safe environment;

(B) practice safety rules and regulations;

(C) identify safety precautions and hazards to ensure a safe environment;

(D) use appropriate safety practices and equipment;

(E) select, inspect, and use personal protective equipment such as respiratory protection and fall protection equipment to ensure a safe environment;

(F) inspect personal protective equipment to ensure safety;

(G) report defects found in personal protective equipment;

(H) wear appropriate personal protective equipment;

(I) employ hierarchy and workflow of the site to ensure safety;

(J) perform site safety procedures at all times; and

(K) use various safety barriers.

(27) The student establishes specific goals to manage project assignments in a timely manner. The student is expected to:

(A) establish project goals in order to meet project specifications and deadlines; and

(B) organize work teams to effectively manage assignments.

(28) The student works as an individual and as a team member to accomplish assignments. The student is expected to:

(A) use human relations skills to work cooperatively with coworkers representing different cultures, genders, and backgrounds;

(B) track team goals to contribute constructively and positively to the team;

(C) match team members to appropriate activities;

(D) manage skills to effectively accomplish assignments;

(E) effectively use conflict resolution skills with coworkers to maintain a smooth workflow; and

(F) use mentoring skills to inspire and motivate others to achieve and enhance performance.

(29) The student exhibits personal accountability, integrity, and responsibility to enhance confidence among coworkers. The student is expected to:

(A) apply the professional and ethical standards of the industry to personal conduct;

(B) practice professional and ethical standards;

(C) maintain personal integrity;

(D) promote personal and professional integrity in coworkers; and

(E) recognize integrity in others.

(30) The student reads regulations and contracts to ensure ethical and safety elements are observed. The student is expected to:

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(A) study regulations and codes to identify those applicable to the local area;

(B) locate and implement regulations and codes applicable to tasks and projects;

(C) comply with local, state, and federal agencies and model code-setting organizations;

(D) read and explain the various aspects of service contracts to ensure compliance;

(E) evaluate and follow service contracts;

(F) recognize the relationship between the various parties to a contract in order to interpret responsibilities;

(G) fulfill contractual roles and responsibilities;

(H) recognize the definition of specialized words or phrases to fully understand documents and contracts;

(I) use industry jargon or terminology appropriately;

(J) use industry acronyms correctly;

(K) use words with multiple meanings correctly in context; and

(L) use ethical and legal standards to avoid conflicts of interest.

(31) The student recognizes legal and ethical relationships between employees and employers to establish workplace and job site rules, regulations, and guidelines. The student is expected to:

(A) access appropriate resources to identify the roles, rights, and responsibilities of an employee and an employer; and

(B) examine insurance documentation to determine liability issues associated with a job.

(32) The student recognizes a positive work ethic to comply with employment requirements. The student is expected to:

(A) exhibit behaviors showing reliability and dependability;

(B) recognize appropriate dress for the work environment; and

(C) recognize the required employment forms and documentation such as I-9, work visa, W-4, and licensures to meet employment requirements.

(33) The student recognizes requirements for career advancement to plan for continuing education and training. The student is expected to:

(A) identify opportunities for career advancement to formulate career goals;

(B) identify a career ladder;

(C) develop a career advancement plan;

(D) implement a career advancement plan;

(E) review progress of a career advancement plan;

(F) maintain positive interpersonal skills to enhance advancement potential;

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(G) perform quality work as measured by a performance evaluation;

(H) pursue education and training opportunities to acquire skills necessary for career advancement;

(I) document successful completion of education and training opportunities;

(J) participate in professional development opportunities such as professional organizations and associations, trade shows, and seminars;

(K) read professional journals, magazines, manufacturers' catalogs, industry publications, and Internet sites to keep current on industry trends; and

(L) identify and prepare for new and emerging occupations, practices, and procedures as well as declining occupations and practices.

(34) The student examines the organization and structure of various segments of the industry to prepare for career advancement. The student is expected to:

(A) recognize segments of the construction industry and show the relationships to specialty areas;

(B) obtain necessary knowledge and skills to enhance employability;

(C) research local and regional labor markets and job growth information to project potential for advancement;

(D) identify sources of career information;

(E) identify job opportunities for the trade;

(F) identify organizations that offer career and job placement;

(G) analyze potential growth of identified careers;

(H) apply labor market and job growth information to career goals;

(I) examine licensing, certification, and credentialing requirements at the national, state, and local levels to achieve compliance;

(J) align licensing, certification, and credentialing requirements to career goals in order to plan for career advancement;

(K) use technologies and resources to research licensing, certification, and credentialing;

(L) evaluate and select suitable sources of licensing, certification, and credentialing;

(M) identify licenses, certifications, and credentials applicable to career goals; and

(N) document sources and agencies for licensing and certification and credentialing information, including contact information.

(35) The student recognizes the responsibilities and personal characteristics of a professional in architecture and construction to develop personal goals for professionalism. The student is expected to:

(A) research information to identify appropriate responsibilities and personal characteristics;

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(B) practice the responsibilities and characteristics of a professional in architecture and construction;

(C) identify all critical functions;

(D) document customer satisfaction;

(E) present a professional image in the workplace or job site to enhance career advancement;

(F) maintain appropriate professional memberships; and

(G) follow rules, regulations, and guidelines.

(36) The student initiates and maintains a career portfolio to document knowledge, skills, and abilities. The student is expected to:

(A) select educational and work history highlights to create a personal resumé;

(B) develop a resumé using word processing technology;

(C) contact professional references to acquire recommendations;

(D) obtain appropriate letters of recommendation;

(E) maintain a record of work experiences, licenses, certifications, and education to build a portfolio;

(F) document work experience;

(G) document receipt of licenses, certifications, and credentialing; and

(H) document completion of education and training.

(37) The student reads technical drawings and documents to plan a project. The student is expected to:

(A) interpret blueprints and drawings to assist with project planning;

(B) recognize elements and symbols of blueprints and drawings;

(C) relate information on blueprints to actual locations on the print;

(D) recognize different classifications of drawings; and

(E) interpret and use drawing dimensions.

(38) The student uses and maintains appropriate tools, machines, and equipment to accomplish project goals. The student is expected to:

(A) select tools, machinery, and equipment to match requirements of the project;

(B) safely operate tools, machinery, and equipment;

(C) properly maintain and care for tools, machines, and equipment;

(D) use tools, machines, and equipment productively and efficiently in alignment with industry standards;

(E) identify sources of information concerning state-of-the-art tools, equipment, materials, technologies, and methodologies;

(F) read current periodicals, industry publications, and manufacturers' catalogs; and

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(G) use state-of-the-art tools, equipment, materials, technologies, and methodologies.

(39) The student recognizes, identifies, and discusses the appropriate safe use and maintenance of tools used in construction careers. The student is expected to:

(A) recognize, identify, and discuss the appropriate safe use and maintenance of some of the commonly used power tools in construction such as hammers, screwdrivers, sledgehammers, ripping bars and nail pullers, pliers and wire cutters, rulers and other measuring tools, levels, squares, plumb bob, chalk lines, bench vises, clamps, saws, files and rasps, chisels and punches, wrenches, sockets and ratchets, torque wrenches, wedges, utility knives, chain falls and come-alongs, wire brushes, and shovels;

(B) identify and describe the use of slings and common rigging hardware;

(C) describe basic inspection techniques and rejection criteria used for slings and hardware;

(D) describe basic hitch configurations and their proper connections;

(E) describe basic load-handling safety practices; and

(F) demonstrate proper use of American National Standards Institute hand signals.

Interior Design

(1) The student demonstrates effective decision-making skills related to housing needs throughout the life cycle. The student is expected to:

(A) determine housing characteristics common to various cultures and regions;

(B) describe factors affecting housing choices;

(C) describe the relationship of housing and family economics;

(D) assess the impact of demographic trends and psychological, physiological, and social needs on housing decisions;

(E) analyze the impact of housing decisions on family relationships and the management of multiple family, community, and wage-earner roles;

(F) analyze aspects of community planning that impact housing decisions; and

(G) compare the availability, desirability, and financial feasibility of housing alternatives.

(2) The student demonstrates effective management practices related to the housing budget. The student is expected to:

(A) explain consumer rights and responsibilities associated with housing;

(B) contrast the impact of needs and wants on the costs of housing;

(C) analyze legal and financial aspects of purchasing and leasing housing; and

(D) summarize laws and public policies that impact housing decisions and costs.

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The student recommends practices that will create a safe, secure, and well-maintained home. The student is expected to:

(A) explain the effect of housing conditions on health and safety;

(B) develop a plan for detecting safety hazards and maintaining a safe home; and

(C) describe housing features for individuals with special needs.

(4) The student proposes methods to create quality living environments. The student is expected to:

(A) apply elements and principles of design to living environments;

(B) apply principles of space utilization, zoning, and traffic patterns in planning and furnishing housing; and

(C) propose design and furnishings features to meet the special needs of individuals and families.

(5) The student considers factors affecting housing construction when making planning and consumer decisions related to housing. The student is expected to:

(A) identify architectural styles exemplified in housing;

(B) summarize considerations for housing site selection;

(C) evaluate basic housing construction and finishing considerations; and

(D) describe the effects of technology on current and future housing trends.

(6) The student evaluates factors influencing the housing industry. The student is expected to:

(A) describe the interrelationship of the housing industry and the economy; and

(B) determine sources and availability of construction materials.

(7) The student assesses environmental issues affecting housing. The student is expected to:

(A) evaluate the effects of landscaping on housing and the larger environment; and

(B) determine techniques, materials, and technology applications that can be used in housing to conserve energy and other resources.

(8) The student uses effective design practices to evaluate residential and nonresidential interiors. The student is expected to:

(A) apply elements and principles of design to interiors;

(B) plan for effective use of space zones and placement of furnishings;

(C) determine drafting techniques, including scaled drawings, that facilitate space planning;

(D) determine the effect of technology on interior design practices;

(E) differentiate design practices to meet individual, business, and special needs; and

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(F) describe energy conservation practices that affect interior design and summarize laws, public policies, and regulations impacting interior environments.

(9) The student determines appropriate lighting for residential and nonresidential interiors. The student is expected to:

(A) analyze the functions and principles of lighting;

(B) compare lighting types and methods of control; and

(C) recommend lighting applications for specific interior needs.

(10) The student chooses appropriate background materials to complement various residential and nonresidential interior settings. The student is expected to:

(A) compare criteria for selection, use, and care of floor coverings;

(B) evaluate selection, use, and care of wall treatments;

(C) explain selection and care of ceilings; and

(D) evaluate the selection, use, and care of window treatments and their suitability for various window types.

(11) The student demonstrates effective decision-making skills in applying principles of design and space to residential and nonresidential interior environments. The student is expected to:

(A) describe the relationship of interior decisions to individual and family needs and wants;

(B) describe the influences of demographics, society, and culture on interior design decisions;

(C) explain the relationship of economics to interior environments and propose strategies for controlling costs and allocating resources; and

(D) budget for acquisition of products to enhance interior environments.

(12) The student evaluates the role of furniture in interior design for residential and nonresidential settings. The student is expected to:

(A) describe characteristics of period styles;

(B) determine the influence of period styles on interior design;

(C) summarize selection and care of quality furniture;

(D) assess aesthetic and functional aspects of furniture; and

(E) describe the impact of technology on furniture.

(13) The student determines the role of appliances in interior design for residential and nonresidential settings. The student is expected to:

(A) analyze the functional and aesthetic aspects of appliances;

(B) determine the process for selection of appliances;

(C) explain the safe use and care of appliances; and

(D) describe the impact of technology on appliances.

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(14) The student evaluates the role of accessories in interior design for residential and nonresidential settings. The student is expected to:

(A) identify types of accessories;

(B) describe criteria for selection of accessories;

(C) analyze care of accessories; and

(D) practice guidelines for arranging accessories.

(15) The student applies the concepts and skills of the industry to simulated work situations. The student is expected to:

(A) customize screen menus to fit specific problems or needs;

(B) construct points, lines, and other geometric forms using accepted computer-aided design methods;

(C) create a freehand simple one-point perspective;

(D) use technology to create a bill of materials;

(E) use technology to create and modify architectural interior drawings; and

(F) plot architectural interior drawings for presentation.

(16) The student develops and organizes ideas from the surroundings. The student is expected to:

(A) illustrate ideas for interior design from direct observation, experiences, and imagination; and

(B) compare and contrast the use of interior design elements (color, texture, form, line, space, and value) and interior design principles (emphasis, pattern, rhythm, balance, proportion, and unity) in personal interior design artworks and those of others using vocabulary accurately.

(17) The student expresses ideas through original interior design projects using a variety of media with appropriate skill. The student is expected to:

(A) create visual solutions by elaborating on direct observation, experiences, and imagination;

(B) create designs for practical applications; and

(C) demonstrate effective use of interior design media and tools in design, drawing, painting, printmaking, and sculpture such as model building.

(18) The student maintains a career portfolio to document knowledge, skills, and abilities. The student is expected to:

(A) select educational and work history highlights to create a personal resumé;

(B) develop a resumé using word processing technology;

(C) contact professional references to acquire recommendations;

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(D) obtain appropriate letters of recommendation;

(E) maintain a record of work experiences, licenses, certifications, and education to build a portfolio;

(F) document work experience;

(G) document receipt of licenses, certifications, and credentialing; and

(H) document completion of education and training.

(19) The student applies the concepts and skills of the profession to simulated or actual work situations. The student is expected to:

(A) use problem-solving skills to analyze a situation to identify a problem to be solved;

(B) break a complex problem into component parts that can be analyzed and solved separately;

(C) strive for accuracy and precision;

(D) work independently;

(E) work collaboratively;

(F) research an interior design project;

(G) design and present an effective interior design product; and

(H) present a final interior design product for critique.

Advanced Interior Design

(1) The student knows the employability characteristics of a successful worker in the modern workplace. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements in the field of architectural interior design;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) identify employers' expectations and appropriate work habits;

(D) apply the competencies related to resources, information, systems, and technology in appropriate settings and situations;

(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations; and

(F) maintain a project portfolio that documents interior design projects using a variety of multimedia techniques with a professional resumé.

(2) The student applies core academic skills to the requirements of architectural interior design. The student is expected to:

(A) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(B) successfully complete work orders and related paperwork;

(C) estimate supplies, materials, and labor costs; and

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(D) read and interpret schematics, floor plans, work drawings, catalogs, manuals, and bulletins.

(3) The student knows the concepts and skills that form the core knowledge of architectural interior design. The student is expected to:

(A) use interior design theory, layout and design lines, symbols, and drawings;

(B) demonstrate knowledge of the theory and use of color in interior design; and

(C) demonstrate knowledge of the principles of computer-aided drafting.

(4) The student knows the function and application of the tools, equipment, technologies, and materials used in architectural interior design. The student is expected to:

(A) safely use tools, materials, and equipment commonly employed in the field of architectural interior design;

(B) properly handle and dispose of environmentally hazardous materials used in the field of architectural interior design; and

(C) demonstrate knowledge of new and emerging technologies that may affect the field of architectural interior design.

(5) The student applies the concepts and skills of interior design to simulated and actual work situations. The student is expected to:

(A) use architectural lettering techniques;

(B) render freehand commercial or residential interior design working drawings;

(C) draw a single-line floor plan from design development techniques for a residential or commercial project;

(D) choose interior furnishings and finish materials for a residence or a commercial office interior;

(E) prepare and draw dimension plans for construction documents;

(F) produce interior drawings using both one-point and two-point perspective;

(G) develop and complete schematic design drawings;

(H) apply the essential knowledge and skills in architectural interior design to career preparation learning experiences, including, but not limited to, job shadowing, mentoring, or apprenticeship training programs;

(I) recognize sustainable design as it relates to interior design;

(J) define green architecture as related to the field of interior design;

(K) customize screen menus in drawing programs;

(L) use industry accepted computer-aided drafting skills;

(M) research the Americans with Disabilities Act; and

(N) research the guidelines for kitchen and bath design as defined by The National Kitchen and Bath Industry.

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(6) The student understands the concepts and skills that form the core knowledge of furniture repair and upholstery. The student is expected to:

(A) identify styles and periods of furniture;

(B) identify the various types and properties of woods;

(C) recognize traditional, period, and design styles of upholstery; and

(D) identify different fabrics, materials, and finishes and their characteristics.

(7) The student knows the function and application of the tools, equipment, technologies, and materials used in furniture repair and upholstery. The student is expected to:

(A) safely use tools, materials, and equipment commonly employed in the field of furniture repair and upholstery services;

(B) properly handle and dispose of environmentally hazardous materials used in the field of furniture repair and upholstery; and

(C) demonstrate knowledge of new and emerging technologies that may affect the field of furniture repair and upholstery services.

(8) The student applies the concepts and skills of interior design to simulated and actual work situations. The student is expected to:

(A) use the woodworking skills required for furniture finishing and repair;

(B) demonstrate knowledge of the types, properties, and uses of paints, varnishes, polishes, and waxes;

(C) disassemble and reassemble furniture;

(D) repair dents, mars, and scratches by using fillers and stains;

(E) perform the tasks of fabrication and repair and disassembly and reassembly such as tacking, nailing, gluing, measuring, layout, cutting, sewing, and fitting materials;

(F) apply filling, padding, springs, and fabric;

(G) apply the essential knowledge and skills in furniture repair and upholstery services to career preparation learning experiences, including, but not limited to, job shadowing, mentoring, and apprenticeship training;

(H) use problem-solving skills to analyze a situation to identify a problem to be solved;

(I) break a complex problem into component parts that can be analyzed and solved separately;

(J) strive for accuracy and precision;

(K) work independently;

(L) work collaboratively;

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(M) research an architectural project;

(N) design and present an effective interior design product; and

(O) present a final interior design product for critique.

Practicum in Interior Design

(1) The student determines the use of elements and principles of design in residential and nonresidential environments and their furnishings. The student is expected to:

(A) identify the elements of design;

(B) exhibit how the elements of design can create various effects;

(C) list the principles of design;

(D) explain how the principles and elements of design differ;

(E) apply guidelines for coordinating furnishings; and

(F) analyze societal and cultural influences on the design of residential and nonresidential environments and their furnishings.

(2) The student analyzes the workmanship, characteristics, use, and care of materials used in the design and construction of residential and nonresidential furnishings and equipment. The student is expected to:

(A) analyze characteristics of materials and workmanship in relationship to durability and use;

(B) identify characteristics of materials and workmanship in relationship to appearance, performance, use, and care of furnishings;

(C) explain labeling requirements and appropriate procedures for the care of various furnishings;

(D) interpret information provided in equipment use and care manuals; and

(E) demonstrate procedures for the care and maintenance of different types of furnishings and equipment.

(3) The student determines treatments and accessories suitable for residential and nonresidential applications. The student is expected to:

(A) analyze products to determine the appropriate style of design;

(B) determine appropriate use of accessories, lighting, materials, and space in various environments;

(C) describe trends in materials, accessories, lighting, and use of space;

(D) illustrate appropriate window treatments for specific windows;

(E) evaluate cost considerations in accessorizing for various settings;

(F) describe characteristics, use, and care of wall treatments; and

(G) identify characteristics of types of flooring in relationship to design and construction.

(4) The student assesses factors influencing the selection of furniture and equipment for residential and nonresidential applications. The student is expected to:

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(A) describe furniture and equipment used in residential and nonresidential applications;

(B) compare furniture and equipment needs of families in different stages of the life cycle;

(C) evaluate economic considerations when selecting furniture and equipment;

(D) arrange furniture and equipment to accommodate floor plans to meet needs and wants;

(E) describe considerations for selecting furniture and equipment to accommodate persons with special needs; and

(F) use sources of information on changing trends and technology related to furnishings and equipment.

(5) The student applies safety and sanitation practices. The student is expected to:

(A) apply safety rules in performing various workplace procedures according to industry standards;

(B) identify potential hazards and prevention practices;

(C) summarize laws pertaining to safety and sanitation practices;

(D) demonstrate appropriate responses to emergency situations; and

(E) determine workplace procedures that protect the environment.

(6) The student determines appropriate use and care of tools and equipment used in construction of furnishings. The student is expected to:

(A) identify tools and equipment used in construction of furnishings;

(B) demonstrate safe and skillful tool care and use; and

(C) describe the impact of technology on tools, equipment, and construction.

(7) The student demonstrates skills in selected product design and construction. The student is expected to:

(A) appraise characteristics of good workmanship in furnishings products;

(B) use knowledge of design application, selection, and construction to complete furnishings projects; and

(C) analyze uses of technology in furnishings, design, and construction.

(8) The student identifies types of business promotion practices and their benefit to the housing and furnishings retailer. The student is expected to:

(A) discuss business promotion objectives in the retail housing and furnishings industry;

(B) analyze techniques using sales promotion, advertising, and displays;

(C) describe the use of technology and other forms of advertising media in housing and furnishings business promotions;

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(D) explain how business promotion reflects the environment in which a person lives; and

(E) predict how societal trends and changing demographics influence housing and furnishings business promotions.

(9) The student evaluates customer relations as a tool for successful business operations. The student is expected to:

(A) analyze the importance of good customer relations in building and maintaining a business;

(B) demonstrate techniques for maintaining good client relationships; and

(C) describe conflict resolution techniques when dealing with customer complaints.

(10) The student exhibits employability skills that lead to job success in the housing, furnishings, and equipment industries. The student is expected to:

(A) demonstrate effective verbal, nonverbal, written, and electronic communication skills;

(B) demonstrate effective methods to secure, maintain, and terminate employment;

(C) demonstrate positive interpersonal skills, including conflict resolution, negotiation, teamwork, and leadership;

(D) evaluate the relationship of good physical and mental health to job success and achievement;

(E) demonstrate appropriate grooming and appearance for the workplace;

(F) demonstrate appropriate business and personal etiquette in the workplace;

(G) exhibit productive work habits and attitudes; and

(H) maintain a project portfolio that documents interior design projects using a variety of multimedia techniques with a professional resumé.

(11) The student determines employment opportunities and preparation requirements for careers in the housing, furnishings, and equipment industries. The student is expected to:

(A) determine preparation requirements for various levels of employment in a variety of careers in the housing, furnishings, and equipment industries;

(B) analyze the future employment outlook in the housing, furnishings, and equipment industries;

(C) describe entrepreneurial opportunities in the housing, furnishings, and equipment industries;

(D) determine how interests, abilities, personal priorities, and family responsibilities affect career choice;

(E) compare rewards and demands for various levels of employment in a variety of careers; and

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(F) determine continuing education opportunities that enhance career advancement and promote lifelong learning.

(12) The student demonstrates ethical and legal practices for careers in the housing, furnishings, and equipment industries. The student is expected to:

(A) summarize the rights and responsibilities of employers and employees;

(B) exhibit ethical practices as defined by the housing, furnishings, and equipment industries; and

(C) analyze legal aspects of the housing, furnishings, and equipment industries.

Architectural Design

(1) The student knows the employability characteristics of a successful professional in the modern workplace. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements in the field of architectural drafting;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) identify employers' expectations and appropriate work habits;

(D) apply the competencies related to resources, information, systems, and technology in appropriate settings and situations; and

(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations.

(2) The student applies key cognitive skills and academic behaviors to the requirements of architectural studies. The student is expected to:

(A) self-monitor learning needs and seek assistance when needed;

(B) use study habits necessary to manage academic pursuits and requirements;

(C) strive for accuracy and precision;

(D) complete and master tasks;

(E) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(F) successfully complete work orders and related paperwork;

(G) estimate jobs, schedules, and practices related to legal restrictions;

(H) read and interpret appropriate architectural symbols, schematics, blueprints, work drawings, manuals, and bulletins; and

(I) use descriptive geometry related to auxiliary views, revolutions, intersections, and piping drawings.

(3) The student knows the concepts and skills that form the technical knowledge of architectural design. The student is expected to:

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(A) demonstrate knowledge of architectural design principles;

(B) determine building code and zoning requirements for building types in a selected area; and

(C) demonstrate knowledge of the various grades and types of construction materials.

(4) The student knows the function and application of the tools, equipment, technologies, and materials used in architectural drawing. The student is expected to:

(A) safely use the tools, materials, and equipment commonly employed in the field of architectural computer-aided drafting;

(B) properly handle and dispose of environmentally hazardous materials; and

(C) demonstrate knowledge of new and emerging technologies that may affect the field of architecture.

(5) The student applies the concepts and skills of the profession to simulated or actual work situations. The student is expected to:

(A) use problem-solving skills to analyze a situation to identify a problem to be solved;

(B) break a complex problem into component parts that can be analyzed and solved separately;

(C) strive for accuracy and precision;

(D) work independently;

(E) work collaboratively;

(F) research an architectural project;

(G) design and present an effective architectural product;

(H) present a final architectural product for critique;

(I) use architectural lettering techniques;

(J) develop preliminary sketches of a commercial or residential architectural design;

(K) use traditional technical architectural drafting techniques to create drawings;

(L) demonstrate through drawings the development of maximum efficiency of circulation within areas or rooms;

(M) develop a site plan using maximum orientation of the building relative to views, sun, and wind direction;

(N) develop building designs to ensure compatibility between interior and exterior to enhance overall appearance;

(O) draw schematic site plans, floor plans, building elevations, sections, perspectives, and character sketches from bubble diagrams;

(P) draw scaled wall thickness plans, elevations, and sections;

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(Q) develop details of floor and wall sections as required;

(R) demonstrate knowledge of the Americans with Disabilities Act; and

(S) assemble an architectural design in three dimensions.

(6) The student applies the concepts and skills of the profession to simulated or actual work situations. The student is expected to:

(A) customize screen menus to fit specific problems or needs;

(B) construct points, lines, and other geometric forms using accepted computer-aided design methods;

(C) create a freehand simple one-point perspective;

(D) use a computer system to create a bill of materials;

(E) use a computer system to create and modify architectural drawings; and

(F) plot architectural drawings for presentation.

(7) The student begins exploration, development, and organization of ideas from the surroundings. The student is expected to:

(A) begin illustrating ideas for architectural projects from direct observation, experiences, and imagination; and

(B) begin comparing and contrasting the use of architectural elements such as color, texture, form, line, space, value, and architectural principles such as emphasis, pattern, rhythm, balance, proportion, and unity in personal architectural projects and those of others using vocabulary accurately.

(8) The student begins expressing ideas through original architectural projects using a variety of media with appropriate skill. The student is expected to:

(A) create beginning visual solutions by elaborating on direct observation, experiences, and imagination;

(B) create beginning designs for practical applications; and

(C) demonstrate beginning effective use of architectural media and tools in design, drawing, painting, printmaking, and sculpture such as model building.

(9) The student demonstrates an understanding of architectural history and culture as records of human achievement from ancient Egypt to the present. The student is expected to:

(A) compare and contrast historical and contemporary styles, identifying general themes and trends;

(B) describe general characteristics in architectural projects from a variety of cultures; and

(C) compare and contrast career and vocational opportunities in architecture.

(10) The student makes beginning informed judgments about personal architectural projects and the architectural projects of others. The student is expected to:

(A) interpret, evaluate, and justify architectural artistic decisions in personal architectural projects; and

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(B) select and analyze original architectural projects, portfolios, and exhibitions by peers and others to form precise conclusions about formal qualities, historical and cultural contexts, intents, and meanings.

(11) The student makes informed career decisions that reflect career goals. The student is expected to:

(A) determine employment and entrepreneurial opportunities and preparation requirements in architectural design and related fields;

(B) propose short-term and long-term career goals;

(C) describe technology used in architectural careers; and

(D) maintain a project portfolio that documents experience by using graphic or written documentation of architectural-related projects and a professional resumé that should include select educational and work history; professional references; appropriate letters of recommendation, record of work experiences, licenses, and certifications; receipt of licenses, certifications, and credentialing; and completion of education and training.

(12) The student applies communication, science, and mathematics knowledge and skills to architectural projects. The student is expected to:

(A) prepare professional communications, technical reports, and presentations;

(B) use mathematical equations; and

(C) apply scientific principles and concepts.

(13) The student knows the concept of energy. The student is expected to:

(A) identify the nature of energy;

(B) relate potential energy, kinetic energy, and heat energy to conservation;

(C) create an energy model;

(D) evaluate different methods of energy transfer;

(E) recognize sustainable design as it relates to architectural design; and

(F) define green architecture as related to the field of architecture.

Advanced Architectural Design

(1) The student knows the employability characteristics of a successful worker in architectural design. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements in the field of architectural drafting;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) identify employers' expectations and appropriate work habits;

(D) apply the competencies related to resources, information, systems, and technology in appropriate settings and situations; and

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(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations.

(2) The student relates core academic skills to the requirements of architectural drafting. The student is expected to:

(A) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(B) successfully complete work orders and related paperwork;

(C) estimate jobs, schedules, and industry standard practices related to legal restrictions;

(D) read and interpret appropriate architectural symbols, schematics, blueprints, work drawings, manuals, and bulletins; and

(E) use descriptive geometry related to auxiliary views, revolutions, intersections, and piping drawings.

(3) The student knows the concepts and skills that form the technical knowledge of architectural computer-aided drafting. The student is expected to:

(A) demonstrate knowledge of architectural design principles;

(B) determine building code and zoning requirements for building types in a selected area; and

(C) demonstrate knowledge of the various grades and types of construction materials.

(4) The student knows the function and application of the tools, equipment, technologies, and materials used in architectural computer-aided drafting. The student is expected to:

(A) safely use the tools, materials, and equipment commonly employed in the field of architectural computer-aided drafting;

(B) properly handle and dispose of environmentally hazardous materials used in the field of architectural computer-aided drafting; and

(C) demonstrate knowledge of new and emerging technologies that may affect the field of architectural computer-aided drafting.

(5) The student applies the concepts and skills of the trade to simulated and actual work situations. The student is expected to:

(A) use problem-solving skills to analyze a situation to identify a problem to be solved;

(B) break a complex problem into component parts that can be analyzed and solved separately;

(C) strive for accuracy and precision;

(D) work independently;

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(E) work collaboratively;

(F) research an architectural project;

(G) design and present an effective architectural product;

(H) present a final architectural product for critique;

(I) use architectural lettering techniques;

(J) develop preliminary sketches of a house plan or commercial interior space;

(K) demonstrate through drawings the development of maximum efficiency of circulation within areas or rooms;

(L) develop a site plan using maximum orientation of the building relative to views, sun, and wind direction;

(M) draw building designs and styles to ensure compatibility between interior and exterior to enhance overall appearance;

(N) draw schematic site plans, floor plans, building elevations, sections, perspectives, and character sketches using design development techniques;

(O) draw scaled wall thickness plans, elevations, and sections;

(P) develop details of footing and foundations sections, floor and wall sections, ceiling and roof sections, door and window sections, and other sections as required;

(Q) assemble an architectural design in three dimensions;

(R) research the Green Building Rating System as defined by the United States Green Building Council; and

(S) create a project demonstrating sustainable design as it relates to architectural design as defined by the United States Green Building Council.

(6) The student applies the concepts and skills of the trade to simulated and actual work situations. The student is expected to:

(A) customize screen menus to fit specific problems or needs;

(B) construct architectural drawings using advanced computer-aided design drafting skills;

(C) create two- and three-point perspectives;

(D) create three-dimensional solid models;

(E) view three-dimensional objects in several different positions;

(F) use a computer system to create a bill of materials;

(G) use a computer-aided drafting system to create and modify commercial or residential architectural drawings;

(H) plot architectural drawings for presentation;

(I) render three-dimensional objects with applied materials; and

(J) animate a path through a three-dimensional computer-aided project.

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The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:

(A) describe how teams function;

(B) use teamwork to solve problems;

(C) distinguish between the roles of team leaders and team members;

(D) identify characteristics of good leaders;

(E) identify employers' expectations and appropriate work habits;

(F) define discrimination, harassment, and equality;

(G) use time-management techniques to develop and maintain work schedules and meet deadlines; and

(H) complete work according to established criteria.

(8) The student sustains exploration, development, and organization of ideas from their surroundings. The student is expected to:

(A) use advanced skills to illustrate ideas for architectural projects from direct observation, experiences, and imagination; and

(B) use advanced skills comparing and contrasting the use of architectural elements such as color, texture, form, line, space, and value and architectural principles such as emphasis, pattern, rhythm, balance, proportion, and unity in personal architectural projects and those of others using vocabulary accurately.

(9) The student uses advanced skills expressing ideas through original architectural projects using a variety of media with appropriate skill. The student is expected to:

(A) create, using advanced skills, visual solutions by elaborating on direct observation, experiences, and imagination;

(B) create, using advanced skills, designs for practical applications; and

(C) demonstrate, using advanced skills, effective use of architectural media and tools in design, drawing, painting, printmaking, and sculpture such as advanced model building.

(10) The student demonstrates an understanding of architectural history and culture as records of human achievement by examining the connection between twentieth and twenty-first century architecture and art and Greek and Roman architecture and art. The student is expected to:

(A) compare and contrast historical and contemporary styles by identifying general themes and trends;

(B) describe general characteristics in architectural artworks from a variety of cultures; and

(C) compare and contrast career and vocational opportunities in architecture.

(11) The student makes advanced informed judgments about personal architectural projects and the architectural projects of others. The student is expected to:

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(A) interpret, evaluate, and justify architectural artistic decisions in personal architectural artworks; and

(B) select and analyze original architectural artworks, portfolios, and exhibitions by peers and others to form precise conclusions about formal qualities, historical and cultural contexts, intents, and meanings.

(12) The student exhibits employability skills that lead to job success in the architectural design industry. The student is expected to:

(A) demonstrate effective verbal, nonverbal, written, and electronic communication skills;

(B) demonstrate effective methods to secure, maintain, and terminate employment;

(C) demonstrate positive interpersonal skills, including conflict resolution, negotiation, teamwork, and leadership;

(D) evaluate the relationship of good physical and mental health to job success and achievement;

(E) demonstrate appropriate grooming and appearance for the workplace;

(F) demonstrate appropriate business and personal etiquette in the workplace;

(G) exhibit productive work habits and attitudes; and

(H) maintain a project portfolio that documents architectural projects using a variety of multimedia techniques with a professional resumé.

Practicum in Architectural Design

(1) The student knows the employability characteristics of a successful worker in the modern workplace. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements for the student's chosen field;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) demonstrate productive work habits and attitudes;

(D) apply the competencies related to resources, information, interpersonal skills, systems, and technology in appropriate settings and situations; and

(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations.

(2) The student relates communication, mathematics, and science to the requirements of the student's chosen field. The student is expected to:

(A) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(B) apply mathematics principles and practices;

(C) apply and identify science principles used in projects; and

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(D) read and interpret appropriate schematics, charts, graphs, drawings, blueprints, directions, manuals, bulletins, and regulations.

(3) The student knows the function and application of the tools, equipment, technologies, and materials used in the student's chosen field. The student is expected to:

(A) identify and select basic materials and processes used in the student's chosen field;

(B) safely use the hand and power tools and equipment commonly employed in the student's chosen field;

(C) properly handle and dispose of environmentally hazardous materials used in the student's chosen field; and

(D) demonstrate knowledge of new and emerging technologies in the student's chosen field.

(4) The student selects and uses multimedia communication and animation technology to meet specific architectural design needs. The student is expected to:

(A) apply multimedia communication and animation technology to individual or community problems;

(B) describe the factors that affect the use and interpretation of communication products; and

(C) identify and describe the roles of communication such as informing, persuading, and educating.

(5) The student designs multimedia communication and animation products using appropriate architectural design processes and techniques. The student is expected to:

(A) develop or improve communication products that meet specified needs; and

(B) maintain a project portfolio that documents architectural projects using a variety of multimedia techniques.

(6) The student produces multimedia communication and animation products using the appropriate tools, equipment, machines, materials, and processes. The student is expected to:

(A) use a variety of tools, equipment, and machines; and

(B) produce an architectural project using multimedia communications techniques.

(7) The student follows appropriate codes, laws, standards, or regulations. The student is expected to:

(A) identify areas where codes, laws, standards, or regulations may be required;

(B) locate the appropriate codes, laws, standards, or regulations; and

(C) follow the appropriate codes, laws, standards, or regulations.

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(8) The student demonstrates the ability to solve problems, think critically, and make decisions. The student is expected to:

(A) develop or improve a product by following a problem-solving strategy;

(B) apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and

(C) apply decision-making techniques.

(9) The student applies communication, mathematics, and science knowledge and skills to job-related activities. The student is expected to:

(A) use written, verbal, and visual communication techniques consistent with industry standards;

(B) use mathematics concepts in communication technology; and

(C) identify and apply science principles.

(10) The student determines employment opportunities and preparation requirements for careers. The student is expected to:

(A) determine preparation requirements for various levels of employment in a variety of careers;

(B) analyze the future employment outlook;

(C) describe entrepreneurial opportunities;

(D) determine how interests, abilities, personal priorities, and family responsibilities affect career choice;

(E) compare rewards and demands for various levels of employment in a variety of careers; and

(F) determine continuing education opportunities that enhance career advancement and promote lifelong learning.

(11) The student demonstrates ethical and legal practices for careers in the architectural-related workplaces. The student is expected to:

(A) summarize the rights and responsibilities of employers and employees;

(B) exhibit ethical practices as defined by the architectural industry;

(C) analyze legal aspects of the architectural-related workplace;

(D) develop a school-based learning activity in collaboration with the teacher and at least one related industrial mentor that provides an in-depth study of at least one aspect of a selected business, industry, and labor independent study;

(E) present the project in at least two formats such as model, graphic, verbal, written, or other to a panel of students, teachers, and practitioners in the career concentration;

(F) deliver the project's final product(s) that demonstrate(s) the use of a variety of resources, technologies, and communication skills; and

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(G) maintain a project portfolio that documents experience by using graphic or written documentation of architectural-related projects and a professional resumé that should include select educational and work history; professional references; appropriate letters of recommendation; record of work experiences, licenses, and certifications; receipt of licenses, certifications, and credentialing; and completion of education and training.

Construction Management

(1) The student knows the employability characteristics of a successful worker in the modern workplace. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements in the field of construction management;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) identify employers' expectations and appropriate work habits;

(D) apply the competencies related to resources, information, systems, and technology in appropriate settings and situations; and

(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations.

(2) The student applies academic skills to the requirements of construction management. The student is expected to:

(A) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(B) successfully complete work orders and related paperwork;

(C) estimate jobs, schedules, and industry standards related to legal restrictions;

(D) read and interpret appropriate architectural symbols, schematics, blueprints, work drawings, manuals, and bulletins; and

(E) use descriptive geometry related to auxiliary views, revolutions, intersections, and piping drawings.

(3) The student gains knowledge about building materials used in the construction industry, including lumber, sheet materials, engineered wood products, structural concrete, and structural steel. Additionally, the student learns the various fasteners and adhesives used in construction settings. The student is expected to:

(A) identify various types of construction materials and methods;

(B) describe the uses of various types of hardwoods and softwoods;

(C) identify the grades and markings of wood building materials;

(D) describe the proper method of storing and handling building materials;

(E) describe the uses of various types of engineered lumber;

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(F) calculate the quantities of lumber and wood products using industry-standard methods; and

(G) describe the fasteners, anchors, and adhesives used in construction work and explain their uses.

(4) The student describes how a systems model can be used to describe construction activities. The student is expected to:

(A) apply the universal systems model to construction activities;

(B) identify the inputs, processes, outputs, and feedback associated with construction systems;

(C) describe the subsystems used in construction; and

(D) describe how technological systems interact to achieve common goals.

(5) The student selects and uses the proper construction technology to meet practical objectives. The student is expected to:

(A) distinguish between architectural and civil construction systems and related construction systems;

(B) apply construction technology to individual or community problems;

(C) describe the factors that affect the purchase and use of constructed items; and

(D) identify and describe the roles of construction.

(6) The student designs an item for construction using appropriate design processes and techniques. The student is expected to:

(A) describe the design processes and techniques used in construction;

(B) develop or improve a building or structure that meets specified needs; and

(C) identify areas where quality, reliability, and safety can be designed into a building or structure.

(7) The student investigates emerging and innovative construction technologies. The student is expected to:

(A) report on emerging and innovative construction technologies; and

(B) conduct research and experimentation in construction technology.

(8) The student describes quality and how it is measured in construction. The student is expected to:

(A) describe different quality control applications in construction; and

(B) apply continuous quality improvement techniques to the construction of a building or structure.

(9) The student builds buildings or structures using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:

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(A) describe the chemical, mechanical, and physical properties of construction materials;

(B) describe the processes used in construction;

(C) use a variety of tools, equipment, and machines to construct buildings or structures; and

(D) construct a building or structure.

(10) The student works safely with construction tools, equipment, machines, and materials. The student is expected to:

(A) master relevant safety tests;

(B) follow safety manuals, instructions, and requirements;

(C) identify and classify hazardous materials and wastes; and

(D) dispose of hazardous materials and wastes appropriately.

(11) The student describes the importance of maintenance in construction. The student is expected to:

(A) handle and store tools and materials correctly;

(B) locate and perform manufacturers' maintenance procedures on selected tools, equipment, and machines; and

(C) describe the results of negligent or improper maintenance.

(12) The student manages a construction project. The student is expected to:

(A) develop a plan for completing a construction project; and

(B) participate in the organization and operation of a real or simulated construction project.

(13) The student applies the appropriate codes, laws, standards, or regulations related to construction technology. The student is expected to:

(A) describe the importance of codes, laws, standards, or regulations;

(B) identify areas where codes, laws, standards, or regulations may be required; and

(C) comply with the appropriate codes, laws, standards, or regulations.

(14) The student describes the intended and unintended effects of technological solutions. The student is expected to:

(A) use an assessment strategy to determine the risks and benefits of technological developments in construction;

(B) describe how technology has affected individuals, societies, cultures, economies, and environments;

(C) discuss the international effects of construction technology; and

(D) describe the issues related to regional and community planning.

(15) The student identifies the factors that influence the evolution of construction technology. The student is expected to:

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(A) describe how changes in construction technology affect business and industry;

(B) describe how the development and use of construction technology are influenced by past events;

(C) describe change and the factors that affect the adoption or rejection of construction technology; and

(D) describe how and why technology evolves.

(16) The student solves problems, thinks critically, and makes decisions related to construction technology. The student is expected to:

(A) develop or improve a building or structure by following a problem-solving strategy;

(B) apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and

(C) apply decision-making techniques to the selection of technological solutions.

(17) The student identifies the factors that influence the cost of goods and services in construction projects. The student is expected to:

(A) develop a budget for a construction project;

(B) determine the most effective strategies to minimize costs;

(C) identify the financial factors associated with starting and operating construction enterprises; and

(D) explain the role of business in a free enterprise system.

(18) The student applies communication, mathematics, and science knowledge and skills to construction activities. The student is expected to:

(A) use written, verbal, and visual communication techniques consistent with industry standards;

(B) use mathematics concepts in construction technology;

(C) identify and apply science principles used in construction technology; and

(D) use the appropriate units of measure.

(19) The student knows the concepts and skills that form the technical knowledge of building carpentry. The student is expected to:

(A) identify the uses of carpentry hardware and fasteners;

(B) demonstrate knowledge of fire ratings in construction materials; and

(C) demonstrate knowledge of the appropriate building codes that apply to residential and commercial construction.

(20) The student knows the function and application of the tools, equipment, technologies, and materials used in construction carpentry. The student is expected to:

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(A) safely use hand and power tools and equipment commonly employed in carpentry;

(B) properly handle and dispose of environmentally hazardous materials used in carpentry;

(C) safely use the different types of scaffolding employed in building carpentry; and

(D) demonstrate knowledge of new and emerging technologies that may affect construction carpentry.

(21) The student applies the concepts and skills of the construction industry to simulated and actual work situations. The student is expected to:

(A) square, measure, and cut materials to specified dimensions;

(B) rig and handle different types of loads and use the proper hand signals at the job site;

(C) use framing techniques for walls, floors, ceilings, rafters, structural timbers, stairs, trusses, and fireproof metal-studs;

(D) demonstrate the proper principles of drywall application;

(E) install doors, windows, interior and exterior wall covering, and trim; and

(F) apply the essential knowledge and skills in building carpentry to career preparation learning experiences, including, but not limited to, job shadowing, mentoring, and apprenticeship training.

(22) The student knows the proper and safe use of hand and power tools. The student is expected to:

(A) identify the hand tools commonly used by carpenters and describe their uses;

(B) use hand tools in a safe and appropriate manner;

(C) state the general safety rules for operating all power tools, regardless of type;

(D) identify the portable power tools commonly used by carpenters and describe their uses; and

(E) use portable power tools in a safe and appropriate manner.

(23) The student learns how to interpret architectural and engineering working drawings and specifications. The student will become familiar with the symbols and nomenclature specific to the construction industry. The student is expected to:

(A) describe the types of drawings usually included in a set of plans and list the information found on each type;

(B) identify the different types of lines used on construction drawings;

(C) identify selected architectural symbols commonly used to represent materials on plans;

(D) identify selected electrical, mechanical, and plumbing symbols commonly used on plans;

(E) identify selected abbreviations commonly used on plans;

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(F) read and interpret plans, elevations, schedules, sections, and details contained in basic construction drawings;

(G) state the purpose of written specifications;

(H) identify and describe the parts of a specification; and

(I) demonstrate or describe how to perform a quantity takeoff for materials.

(24) The student gains knowledge about the basics of wood framing and the layout and construction of wood-framed floor systems using common and engineered lumber. The student is expected to:

(A) identify the different types of framing systems;

(B) read and interpret drawings and specifications to determine floor system requirements;

(C) identify floor and sill framing and support members;

(D) name the methods used to fasten sills to the foundation;

(E) given specific floor load and span data, select the proper girder and beam size from a list of available girders and beams;

(F) list and recognize different types of bridging;

(G) list and recognize different types of flooring materials;

(H) explain the purposes of subflooring and underlayment;

(I) select the appropriate fasteners to be used in various floor framing systems;

(J) estimate the amount of material needed to frame a floor assembly; and

(K) demonstrate the ability to:<ol type="i">
lay out and construct a floor assembly;
install bridging;
install joists for a cantilever-floor;
install a subfloor using butt-joint plywood or oriented strand board panels; and
install a single floor system using tongue-and-groove plywood or oriented strand board panels.

(25) The student understands how to lay out and frame walls and ceilings, rough-in door and window openings, construct corners and partition tee-bracing walls and ceilings, and apply sheathing. The student is expected to:

(A) identify the components of a wall and ceiling layout;

(B) describe the procedure for laying out a wood frame wall, including plates, corner posts, door and window openings, partition Ts, bracing, and fire stops;

(C) describe the correct procedure for assembling and erecting an exterior wall;

(D) identify the common materials and methods used for installing sheathing on walls;

(E) lay out, assemble, erect, and brace exterior walls for a frame building;

(F) describe wall framing techniques used in masonry construction;

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(G) explain the use of metal studs in wall framing;

(H) explain how to cut and install ceiling joists on a wood frame building; and

(I) estimate the materials required for frame walls and ceilings.

(26) The student investigates various types of framed roofs. The student is expected to:

(A) understand the terms associated with roof framing;

(B) identify the roof framing members used in gable and hip roofs;

(C) identify the methods used to calculate the length of a rafter;

(D) identify the various types of trusses used in roof framing;

(E) use a framing square, speed square, and calculator in laying out a roof;

(F) identify various types of sheathing used in roof construction;

(G) frame a gable roof with vent openings;

(H) erect a gable roof using trusses;

(I) frame a roof opening; and

(J) estimate the materials used for framing and sheathing a roof.

(27) The student describes various types of windows, skylights, and exterior doors. The student is expected to:

(A) identify various types of fixed, sliding, and swinging windows;

(B) identify the parts of a window installation;

(C) state the requirements for proper window installation;

(D) explain how to install a pre-hung window;

(E) identify the common types of exterior doors and explain how they are constructed;

(F) identify the parts of a door installation;

(G) identify types of thresholds used with exterior doors;

(H) install a pre-hung exterior door;

(I) identify the various types of locksets used on exterior doors and explain how the locksets are installed;

(J) install a lockset; and

(K) identify and explain the use and installation of various other door and window hardware, including security hinges, keepers, deadbolts, and peep holes.

(28) The student describes various types of stairs and the common building code requirements related to stairs. The student is expected to:

(A) identify the various types of stairs;

(B) identify the various parts of stairs;

(C) identify the materials used in the construction of stairs;

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(D) interpret construction drawings of stairs;

(E) calculate the total rise, number and size of risers, and the number of size of treads required for a given stairway;

(F) layout and cut stringers, risers, and treads; and

(G) build a small stair unit with a temporary handrail.

(29) The student describes basic product marketing processes and techniques used in construction. The student is expected to:

(A) prepare a marketing plan for an idea, product, or service; and

(B) discuss the effect of customer satisfaction on the image of a product or company.

(30) The student investigates career opportunities, requirements, and expectations in construction technology. The student is expected to:

(A) identify an area of interest in construction and investigate its entry-level and advancement requirements and its growth potential; and

(B) describe the careers available in construction technology.

(31) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:

(A) describe how teams function;

(B) use teamwork to solve problems;

(C) distinguish between the roles of team leaders and team members;

(D) identify characteristics of good leaders;

(E) identify employers' expectations and appropriate work habits;

(F) define discrimination, harassment, and equality;

(G) use time-management techniques to develop and maintain work schedules and meet deadlines; and

(H) complete work according to established criteria.

(32) The student uses a systems approach to investigate mechanical, fluid, electrical, and thermal systems. The student is expected to:

(A) apply the universal systems model to technological activities; and

(B) identify the inputs, processes, outputs, and feedback associated with each of the systems.

(33) The student works safely with mechanical, fluid, electrical, and thermal technology. The student is expected to:

(A) master relevant safety tests;

(B) follow safety manuals, instructions, and requirements; and

(C) make prudent choices in the conservation and use of resources and the disposal of materials.

Skip to main content

(34) The student solves problems, thinks critically, and makes decisions related to technology. The student is expected to:

(A) use specified problem-solving strategies;

(B) apply critical-thinking strategies;

(C) apply decision-making techniques to the selection of technological solutions; and

(D) evaluate the impact of technology on scientific thought, society, and the environment.

(35) The student applies communication, science, and mathematics knowledge and skills to construction activities. The student is expected to:

(A) prepare technical reports and presentations;

(B) solve algebraic equations; and

(C) solve problems in English and System International (SI) units; and perform unit conversions.

Advanced Construction Management

(1) The student selects and uses the appropriate resources to complete construction tasks. The student is expected to:

(A) apply construction technology to individual or local problems;

(B) identify a problem and determine the appropriate resources needed to solve the problem; and

(C) describe the factors that affect the purchase and use of buildings.

(2) The student designs or modifies a structure using designated design processes and techniques. The student is expected to:

(A) develop or improve a building design that meets a specified need; and

(B) use specified design processes to develop and communicate ideas.

(3) The student investigates emerging and innovative construction technologies. The student is expected to:

(A) report on emerging and innovative construction technologies; and

(B) conduct research and experimentation in construction technology to determine its effectiveness.

(4) The student describes quality and how it is measured in construction. The student is expected to:

(A) construct items that meet a specified level of quality;

(B) recommend where and how the quality of a building can be improved; and

(C) explain the factors that affect the quality of buildings.

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The student constructs buildings using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:

(A) describe the chemical, mechanical, and physical properties and standard units of measure of architectural construction materials such as concrete, masonry, and metals;

(B) describe the processes used in construction;

(C) use a variety of tools, equipment, and machines to construct buildings; and

(D) construct a building or model of a building.

(6) The student works safely with construction technology. The student is expected to:

(A) master relevant safety tests;

(B) follow safety manuals, instructions, and requirements;

(C) identify and classify hazardous materials and wastes correctly;

(D) dispose of hazardous materials and wastes appropriately; and

(E) recommend improvements in safety procedures.

(7) The student performs basic maintenance on selected construction equipment and machines. The student is expected to:

(A) handle and store tools and materials correctly;

(B) locate and perform manufacturers' maintenance procedures on selected tools, equipment, and machines; and

(C) develop a maintenance plan for selected machines and equipment.

(8) The student manages construction technology projects. The student is expected to:

(A) develop a plan for completing a construction technology project;

(B) identify and describe the resources required to complete a construction project; and

(C) develop a timeline for completing a project.

(9) The student follows the appropriate codes, laws, standards, or regulations related to architectural construction technology. The student is expected to:

(A) identify areas where codes, laws, standards, or regulations may be required;

(B) locate the appropriate codes, laws, standards, or regulations; and

(C) interpret and follow the appropriate codes, laws, standards, or regulations.

(10) The student solves problems, thinks critically, and makes decisions related to architectural construction. The student is expected to:

(A) develop or improve a building or structure by following a problem-solving strategy;

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(B) apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and

(C) apply decision-making techniques to the selection of technological solutions.

(11) The student determines the cost of constructing a building. The student is expected to:

(A) develop a budget for a construction project; and

(B) determine the most effective strategies to minimize costs.

(12) The student applies communication, mathematics, and science knowledge and skills to construction activities. The student is expected to:

(A) write technical reports;

(B) make technical presentations to groups of individuals;

(C) identify and use mathematics concepts in construction technology; and

(D) identify and apply science principles used in construction technology.

(13) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:

(A) describe how teams function;

(B) use teamwork to solve problems;

(C) distinguish between the roles of team leaders and team members;

(D) identify characteristics of good leaders;

(E) identify employers' expectations and appropriate work habits;

(F) define discrimination, harassment, and equality;

(G) use time-management techniques to develop and maintain work schedules and meet deadlines; and

(H) complete work according to established criteria.

(14) The student gains knowledge about the ingredients of concrete, various types of concrete, and methods to mix concrete. The student is expected to:

(A) identify the properties of cement;

(B) describe the composition of concrete;

(C) perform volume estimates for concrete quantity requirements;

(D) identify types of concrete reinforcement materials and describe their uses;

(E) identify various types of footings and explain their uses;

(F) identify the parts of various types of forms;

(G) explain the safety procedures associated with the construction and use of concrete forms; and

(H) explain how to erect, plumb, and brace a simple concrete form with reinforcement.

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(15) The student uses a systems approach to investigate mechanical, fluid, electrical, and thermal systems. The student is expected to:

(A) apply the universal systems model to technological activities; and

(B) identify the inputs, processes, outputs, and feedback associated with each of the systems.

(16) The student works safely with mechanical, fluid, electrical, and thermal technology. The student is expected to:

(A) master relevant safety tests;

(B) follow safety manuals, instructions, and requirements;

(C) identify and classify hazardous materials and wastes; and

(D) dispose of hazardous materials and wastes appropriately.

(17) The student solves problems, thinks critically, and makes decisions related to construction. The student is expected to:

(A) use problem-solving strategies;

(B) apply critical-thinking strategies;

(C) apply decision-making techniques to the selection of technological solutions; and

(D) evaluate the impact of technology on scientific thought, society, and the environment.

(18) The student applies communication, science, and mathematics knowledge and skills to construction activities. The student is expected to:

(A) prepare technical reports and presentations;

(B) solve algebraic equations;

(C) solve problems in English and System International (SI) units; and

(D) perform unit conversions.

(19) The student knows the laws governing motion. The student is expected to:

(A) analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion;

(B) evaluate the effects of forces on the motion of objects;

(C) develop and interpret a free-body diagram for force analysis; and

(D) analyze motion relative to different frames of reference.

(20) The student knows the concept of momentum. The student is expected to:

(A) identify linear and angular momentum; and

(B) relate the conservation of momentum to linear and angular motion.

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(21) The student knows the concept of waves and vibrations. The student is expected to:

(A) identify and evaluate characteristics of wave motion; and

(B) demonstrate how waves transmit energy.

(22) The student knows the concept of energy conversion. The student is expected to:

(A) evaluate the purpose of energy converters;

(B) identify converters that change one form of energy to another; and

(C) evaluate the efficiency of converting energy from one form to another.

(23) The student knows the concept of energy transduction. The student is expected to:

(A) identify the function of a transducer;

(B) distinguish between an energy converter and a transducer; and

(C) identify transducers that change energy signals from one form to another.

(24) The student knows the concept of radiant energy. The student is expected to:

(A) describe radiation and cite examples;

(B) compare fission and fusion in terms of end products, energy, advantages, and availability; and

(C) compare and contrast different types of radioactive decay.

(25) The student knows the concept of light and optics. The student is expected to:

(A) identify characteristics of optical devices;

(B) analyze the characteristics of light, including reflection, refraction, and interference; and

(C) interpret the effects of wave characteristics in daily applications such as lasers and optics in industrial and medical technology.

(26) The student knows the concept of time constants. The student is expected to:

(A) define a time constant; and

(B) distinguish between a linear and non-linear increase and decrease of a variable with time.

(27) The student describes basic product marketing processes and techniques used in construction. The student is expected to:

(A) prepare a marketing plan for an idea, product, or service; and

(B) discuss the effect of customer satisfaction on the image of a product or company.

Skip to main content

(28) The student investigates career opportunities, requirements, and expectations in construction technology. The student is expected to:

(A) identify an area of interest in construction and investigate its entry-level and advancement requirements and its growth potential; and

(B) describe the careers available in construction.

(29) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:

(A) describe how teams function;

(B) use teamwork to solve problems;

(C) distinguish between the roles of team leaders and team members;

(D) identify characteristics of good leaders;

(E) identify employers' expectations and appropriate work habits;

(F) define discrimination, harassment, and equality;

(G) use time-management techniques to develop and maintain work schedules and meet deadlines; and

(H) complete work according to established criteria.

Construction Technology

(1) The student identifies various employment opportunities in the field of carpentry and the characteristics a carpenter should possess. The student is expected to:

(A) identify job opportunities with their accompanying job duties such as carpentry, building maintenance supervisor, architect, and engineer; and

(B) research careers along with the education, job skills, and experience required to achieve career goals.

(2) The student gains knowledge about building materials used in the construction industry. The student is expected to:

(A) identify various types of building materials and their uses;

(B) state the uses of various types of hardwoods and softwoods;

(C) identify the different grades and markings of wood building materials;

(D) describe the proper method of storing and handling building materials;

(E) state the uses of various types of engineered lumber;

(F) calculate the quantities of lumber and wood products using industry-standard methods; and

(G) describe the fasteners, anchors, and adhesives used in construction work and explain their uses.

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The student applies the proper and safe use of hand and power tools associated with carpentry. The student is expected to:

(A) identify the hand tools commonly used by carpenters and describe their uses;

(B) use hand tools in a safe and appropriate manner;

(C) state the general safety rules for operating all power tools regardless of type;

(D) identify the portable power tools commonly used by carpenters and describe their uses; and

(E) use portable power tools in a safe and appropriate manner.

(4) The student interprets architectural and engineering working drawings and specifications. The student is expected to:

(A) describe the types of drawings usually included in a set of plans and list the information found on each type;

(B) identify the different types of lines used on construction drawings;

(C) identify selected architectural symbols commonly used to represent materials on plans;

(D) identify selected electrical, mechanical, and plumbing symbols commonly used on plans;

(E) identify selected abbreviations commonly used on plans;

(F) read and interpret plans, elevations, schedules, sections, and details contained in basic construction drawings;

(G) state the purpose of written specifications;

(H) identify and describe the parts of a specification; and

(I) demonstrate or describe how to perform a quantity takeoff for materials.

(5) The student gains knowledge of wood framing and the layout and construction of wood-framed floor systems using common and engineered lumber. The student is expected to:

(A) identify the different types of framing systems;

(B) read and interpret drawings and specifications to determine floor system requirements;

(C) identify floor and sill framing and support members;

(D) name the methods used to fasten sills to the foundation;

(E) select the proper girder or beam size from a list of available girders or beams given specific floor load and span data;

(F) list and recognize different types of bridging;

(G) list and recognize different types of flooring materials;

(H) explain the purposes of subflooring and underlayment;

(I) select the appropriate fasteners to be used in various floor framing systems;

(J) estimate the amount of material needed to frame a floor assembly; and

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(K) demonstrate the ability to:<ol type="i">
lay out and construct a floor assembly;
install bridging;
install joists for a cantilever-floor;
install a subfloor using butt-joint plywood or oriented strand board panels; and
install a single floor system using tongue-and-groove plywood or oriented strand board panels.

(6) The student knows how to lay out and frame walls and ceilings, rough-in door and window openings, construct corners and partition tees, brace walls and ceilings, and apply sheathing. The student is expected to:

(A) identify the components of a wall and ceiling layout;

(B) describe the procedure for laying out a wood frame wall, including plates, corner posts, door and window openings, partition tees, bracing, and fire-stops;

(C) describe the correct procedure for assembling and erecting an exterior wall;

(D) identify the common materials and methods used for installing sheathing on walls;

(E) lay out, assemble, erect, and brace exterior walls for a frame building;

(F) describe wall framing techniques used in masonry construction;

(G) explain the use of metal studs in wall framing;

(H) cut and install ceiling joists on a wood frame building; and

(I) estimate the materials required for frame walls and ceilings.

(7) The student gains knowledge of various types of framed roofs and how to frame these roofs using both stick-build and truss-build systems. The student is expected to:

(A) understand the terms associated with roof framing;

(B) identify the roof framing members used in gable and hip roofs;

(C) identify the methods used to calculate the length of a rafter;

(D) identify the various types of trusses used in roof framing;

(E) use a framing square, speed square, and calculator in laying out a roof;

(F) identify various types of sheathing used in roof construction;

(G) frame a gable roof with vent openings;

(H) erect a gable roof using trusses;

(I) frame a roof opening; and

(J) estimate the materials used for framing and sheathing a roof.

(8) The student knows the ingredients of concrete, various types of concrete, and methods to mix concrete. The student is expected to:

Skip to main content

(A) identify the properties of cement;

(B) describe the composition of concrete;

(C) perform volume estimates for concrete quantity requirements;

(D) identify types of concrete reinforcement materials and describe their uses;

(E) identify various types of footings and explain their uses;

(F) identify the parts of various types of forms;

(G) explain the safety procedures associated with the construction and use of concrete forms; and

(H) erect, plumb, and brace a simple concrete form with reinforcement.

(9) The student gains knowledge of various types of windows, skylights, and exterior doors. The student is expected to:

(A) identify various types of fixed, sliding, and swinging windows;

(B) identify the parts of a window installation;

(C) state the requirements for proper window installation;

(D) install a pre-hung window;

(E) identify the common types of exterior doors and explain how they are constructed;

(F) identify the parts of a door installation;

(G) identify types of thresholds used with exterior doors;

(H) install a pre-hung exterior door;

(I) identify the various types of locksets used on exterior doors and explain how the locksets are installed;

(J) install a lockset; and

(K) identify and explain the use and installation of various other door and window hardware, including security hinges, keepers, deadbolts, and peep holes.

(10) The student is introduced to various types of stairs and the common building code requirements related to stairs. The student is expected to:

(A) identify the various types of stairs;

(B) identify the various parts of stairs;

(C) identify the materials used in the construction of stairs;

(D) interpret construction drawings of stairs;

(E) calculate the total rise, number and size of risers, and the number and size of treads required for a given stairway;

(F) lay out and cut stringers, risers, and treads; and

(G) build a small stair unit with a temporary handrail.

Advanced Construction Technology

(1) The student is provided with the knowledge to interpret various types of working drawings as they pertain to commercial construction. The student is expected to:

Skip to main content

(A) recognize the difference between commercial and residential construction drawings;

(B) identify the basic keys, abbreviations, and other references contained in a set of commercial drawings;

(C) accurately read a set of commercial drawings;

(D) identify and document specific items from a door and window schedule;

(E) explain basic construction details and concepts employed in commercial construction; and

(F) calculate the floor area of each room in a floor plan.

(2) The student selects and installs common roofing materials for residential and light commercial projects. The student is expected to:

(A) identify the materials and methods used in roofing;

(B) explain the safety requirements for roof jobs;

(C) install fiberglass shingles on gable and hip roofs;

(D) close up a valley using fiberglass shingles;

(E) explain how to make various roof projections watertight when using fiberglass shingles;

(F) complete the proper cuts and install the main and hip ridge caps using fiberglass shingles;

(G) lay out, cut, and install a cricket or saddle;

(H) install wood shingles and shakes on roofs;

(I) describe how to close up a valley using wood shingles and shakes;

(J) complete the cuts and install the main and hip ridge caps using wood shakes or shingles; and

(K) demonstrate the techniques for installing other selected types of roofing materials.

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(3) The student selects and installs various types of insulation in walls, floors, and attics. The student is expected to:

(A) describe the requirements for insulation;

(B) describe the characteristics of various types of insulation material;

(C) calculate the required amounts of insulation for a structure;

(D) install selected insulation materials;

(E) describe the requirements for moisture control and ventilation;

(F) install selected vapor barriers;

(G) describe various methods of waterproofing;

(H) describe air infiltration control requirements; and

(I) install selected building wraps.

(4) The student learns the processes to install various exterior siding materials. The student is expected to:

(A) describe the purpose of wall insulation and flashing;

(B) install selected common cornices;

(C) demonstrate lap and panel siding estimating methods;

(D) describe the types and applications of common wood siding;

(E) describe fiber-cement siding and its uses;

(F) describe the types and styles of vinyl and metal siding;

(G) describe the types and applications of stucco and masonry veneer finishes; and

(H) install three types of siding commonly used in the local area.

(5) The student knows the types and grades of steel framing materials and the process for installation of metal framing for interior walls, exterior nonbearing walls, and partitions. The student is expected to:

(A) identify the components of a steel framing system;

(B) identify and select the tools and fasteners used in a steel framing systems;

(C) identify applications for steel framing systems;

(D) demonstrate the ability to build back-to-back, box, and L-headers;

(E) layout and install a steel stud structural wall with openings to include bracing and blocking; and

(F) layout and install a steel stud non-structural wall with openings to include bracing blocking.

(6) The student knows various types of gypsum drywall, their uses, and the fastening devices and methods used to install them. The student is expect to:

Skip to main content

(A) identify the different types of drywall and their uses;

(B) select the type and thickness of drywall required for specific installations;

(C) select fasteners for drywall installations;

(D) explain the fastener schedules for different types of drywall installations;

(E) perform single-layer and multi-layer drywall installations using different types of fastening systems, including nails, drywall screws, and adhesives;

(F) install gypsum drywall on steel studs;

(G) explain how soundproofing is achieved in drywall installations; and

(H) estimate material quantities for a drywall installation.

(7) The student knows the materials, tools, and methods used to finish and patch gypsum drywall. The student is expected to:

(A) state the differences between the six levels of finish established by industry standards and distinguish a finish level by observation;

(B) identify the hand tools used in drywall finishing and demonstrate the ability to use these tools;

(C) identify the automatic tools used in drywall finishing;

(D) identify the materials used in drywall finishing and state the purpose and use of each type of material, including compounds, joint reinforcing tapes, trim materials, textures, and coatings;

(E) properly finish drywall using hand tools;

(F) recognize various types of problems that occur in drywall finishes;

(G) identify the causes and correct methods for solving each type of problem; and

(H) patch damaged drywall.

(8) The student installs metal doors and related hardware in steel-framed, wood-framed, and masonry walls. The student is expected to:

(A) identify various types of door jambs and frames and demonstrate the installation procedures for placing selected door jambs and frames in different types of interior partitions;

(B) identify different types of interior doors;

(C) identify different types of interior door hardware and demonstrate the installation procedures for selected types;

(D) list and identify specific items included on a typical door schedule; and

(E) demonstrate the procedure for placing and hanging a selected door.

(9) The student gains knowledge of the materials, layout, and installation of various types of suspended ceilings used in commercial construction as well as ceiling tiles, drywall suspension systems, and pan-type ceilings. The student is expected to:

Skip to main content

(A) establish a level line;

(B) explain the common terms related to sound waves and acoustical ceiling materials;

(C) identify the different types of suspended ceilings;

(D) interpret plans related to ceiling layout;

(E) sketch the ceiling layout for a basic suspended ceiling; and

(F) install selected suspended ceilings.

(10) The student knows the types of trim used in finish work. The student is expected to:

(A) identify the different types of standard moldings and describe their uses;

(B) make square and miter cuts using a miter box or power miter saw;

(C) make coped joint cuts using a coping saw;

(D) select and properly use fasteners to install trim, including door trim, window trim, base trim, and ceiling trim; and

(E) estimate the quantities of different trim materials required for selected rooms.

(11) The student selects and installs base and wall cabinets and countertops. The student is expected to:

(A) state the classes and sizes of typical base and wall kitchen cabinets;

(B) identify cabinet components and hardware and describe their purposes;

(C) lay out factory-made cabinets, countertops, and backsplashes;

(D) explain the installation of an island base;

(E) recognize the common types of woods used to make cabinets;

(F) identify and cut the various types of joints used in cabinetmaking;

(G) build a cabinet from a set of drawings; and

(H) install plastic laminate on a countertop core.

Mill and Cabinetmaking Technology

(1) The student knows the employability characteristics of a successful worker in the modern workplace. The student is expected to:

(A) identify employment opportunities, including entrepreneurship, and preparation requirements for mill and cabinetmaking;

(B) demonstrate the principles of group participation and leadership related to citizenship and career preparation;

(C) identify employers' expectations and appropriate work habits;

(D) apply the competencies related to resources, information, systems, and technology in appropriate settings and situations; and

(E) demonstrate knowledge of the concepts and skills related to health and safety in the workplace, as specified by appropriate government regulations.

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(2) The student relates core academic skills to the requirements of mill and cabinetmaking. The student is expected to:

(A) demonstrate effective verbal and written communication skills with individuals from varied cultures, including fellow workers, management, and customers;

(B) successfully complete work orders and related paperwork;

(C) estimate supplies, materials, and labor costs for work orders;

(D) apply the principles of mathematics for accurate linear and metric measurements; and

(E) read and interpret appropriate blueprints, drawings, charts, and diagrams.

(3) The student knows the concepts and skills that form the core knowledge of mill and cabinetmaking. The student is expected to:

(A) demonstrate knowledge of cabinetmaking design;

(B) demonstrate knowledge of the use of woods, fasteners, hardware, glass, and mirrors; and

(C) demonstrate knowledge of the industrial processes and procedures used in mill and cabinetmaking.

(4) The student knows the function and application of the tools, equipment, technologies, and materials used in mill and cabinetmaking. The student is expected to:

(A) safely use hand and power tools and equipment commonly employed in mill and cabinetmaking;

(B) properly handle and dispose of environmentally hazardous materials used in mill and cabinetmaking;

(C) use the proper procedures in sawing, planing, shaping, turning, boring, mortising, and sanding various types of woods;

(D) demonstrate knowledge of numerical control and computer control production devices; and

(E) demonstrate knowledge of new and emerging technologies that may affect mill and cabinetmaking.

(5) The student applies the concepts and skills of mill and cabinet making to simulated and actual work situations. The student is expected to:

(A) identify and construct the various joints used in cabinetmaking;

(B) use the proper procedures in gluing, clamping, laminating, veneering, and inlaying;

(C) use the proper procedures to construct and install cabinet doors, furniture doors, drawers, drawer guides, shelves, cabinet interiors, legs, posts, table tops, and cabinet tops;

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(D) use proper finishing techniques; and

(E) apply the essential knowledge and skills in mill and cabinetmaking to career preparation learning experiences, including, but not limited to, job shadowing, mentoring, and apprenticeship training.

Building Maintenance Technology

(1) The student identifies various employment opportunities in the field of building maintenance. The student is expected to:

(A) identify job opportunities with their accompanying job duties such as building maintenance technician, building maintenance supervisor, architect, and engineer; and

(B) research construction careers along with the education, job skills, and experience required to achieve that career goal.

(2) The student gains knowledge to interpret various types of working drawings as they pertain to commercial construction. The student becomes familiar with all aspects of contract documents, including architectural, engineering, and shop drawings. The student is expected to:

(A) describe the types of drawings usually included in a set of plans and list the information found on each type;

(B) identify the different types of lines used on construction drawings;

(C) identify selected electrical, mechanical, and plumbing symbols commonly used on plans;

(D) identify selected architectural symbols commonly used to present materials on plans;

(E) identify selected abbreviations commonly used on plans;

(F) read and interpret plans, elevations, schedules, sections, and details contained in basic construction drawings;

(G) describe the purpose of written specifications;

(H) identify and describe the parts of a specification; and

(I) demonstrate how to perform a quantity takeoff for materials.

(3) The student selects and installs common roofing materials for residential and light commercial projects. The student is expected to:

(A) identify the materials and methods used in roofing;

(B) explain the safety requirements for roof jobs;

(C) close up a valley using fiberglass shingles;

(D) explain how to make various roof projections watertight when using fiberglass shingles;

(E) lay out, cut, and install a cricket or saddle;

(F) install wood shingles and shakes on roofs;

(G) describe how to close up a valley using wood shingles and shakes;

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(H) complete the cuts and install the main and hip ridge caps using wood shakes; and

(I) demonstrate the techniques for installing other selected types of roofing materials.

(4) The student selects and installs various types of insulation in walls, floors, and attics. The student becomes familiar with the uses and installation practices for vapor barriers and waterproofing materials. The student is expected to:

(A) demonstrate how to properly remove, replace, and install various types of insulation, including batt, rigid, and blown materials; and

(B) demonstrate how to use and install various vapor barriers and waterproofing materials.

(5) The student installs various exterior siding materials, including wood, metal, vinyl, and cement board siding. The student is expected to:

(A) demonstrate the proper methods to install exterior finish materials, including wood, metal, vinyl, and cement board siding;

(B) identify various fasteners used to install siding, including nails, screws, and adhesives;

(C) describe the types and applications of stucco and masonry veneer finishes; and

(D) install three types of siding commonly used in the local area.

(6) The student gains knowledge of the types and grades of steel framing materials and the process for installation of metal framing for interior walls, exterior nonbearing walls, and partitions. The student is expected to:

(A) identify and use a system to install a steel frame wall or partition;

(B) identify the fastening methods used for steel frame systems; and

(C) identify methods used to secure steel frame systems to supporting structures.

(7) The student knows various types of gypsum drywall, their uses, and the fastening devices and methods used to install them. The student is expected to:

(A) identify the different types of drywall and their uses;

(B) select the type and thickness of drywall required for specific installations;

(C) explain the fastener schedules for different types of drywall installations;

(D) perform single-layer and multi-layer drywall installations using different types of fastening systems, including nails, drywall screws, and adhesives;

(E) install gypsum drywall on steel studs; and

(F) estimate material quantities for a drywall installation.

(8) The student knows the materials, tools, and methods used to finish and patch gypsum drywall. The student is expected to:

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(A) describe the differences between the six levels of finish established by industry standards and distinguish a finish level by observation;

(B) identify the hand tools used in drywall finishing and demonstrate the ability to use these tools;

(C) identify the automatic tools used in drywall finishing;

(D) identify the materials used in drywall finishing and describe the purpose and use of each type of material, including compounds, joint reinforcing tapes, trim materials, and textures and coatings;

(E) properly finish drywall using hand tools;

(F) recognize various types of problems that occur in drywall finishes;

(G) identify the causes and correct method for solving each type of problem; and

(H) patch damaged drywall.

(9) The student installs metal doors and related hardware in steel-framed, wood-framed, and masonry walls. The student is expected to:

(A) identify various types of door jambs and frames and demonstrate the installation procedures for placing selected door jambs and frames in different types of interior partitions;

(B) identify types of interior doors;

(C) identify different types of interior door hardware and demonstrate the installation procedures for selected types;

(E) demonstrate the procedures for placing and hanging a selected door.

(D) list and identify specific items included on a typical door schedule; and

(10) The student gains knowledge of the materials, layout, and installation of various types of suspended ceilings used in commercial construction as well as ceiling tiles, drywall suspension systems, and pan-type ceilings. The student is expected to:

(A) establish a level line;

(B) explain the common terms related to sound waves and acoustical ceiling materials;

(C) identify the different types of suspended ceilings;

(D) interpret plans related to ceiling layout for a suspended ceiling;

(E) sketch the ceiling layout for a suspended ceiling; and

(F) install selected suspended ceilings.

(11) The student knows the various types of trim used in finish work and the proper methods for selecting, cutting, and fastening trim. The student is expected to:

Skip to main content

(A) identify the different types of standard moldings and describe their uses;

(B) make square and miter cuts using a miter box or power miter saw;

(C) make coped joint cuts using a coping saw; and

(D) select and properly use fasteners to install trim, including door trim, window trim, base trim, and ceiling trim.

(12) The student selects and installs base and wall cabinets and countertops. The student is expected to:

(A) describe the classes and sizes of typical base and wall cabinets;

(B) identify cabinet components and hardware and describe their purposes;

(C) lay out factory-made cabinets, countertops, and backsplashes; and

(D) install plastic laminate on a countertop core.

(13) The student selects and installs various types of floor coverings, including carpet, vinyl tile, ceramic tile, and wood flooring systems. The student is expected to:

(A) describe the methods used to install ceramic tile, carpet, and vinyl tile;

(B) make repairs of ceramic tile, carpet, and vinyl tile; and

(C) use and maintain the tools used for the installation and repair of floor systems, including wet saw, trowels, and carpet knives.

Advanced Building Maintenance Technology

(1) The student identifies various employment opportunities in the field of building maintenance. The student is expected to:

(A) identify job opportunities with their accompanying job duties and tasks such as a building maintenance technician, manager, and construction manager; and

(B) research career pathways along with the education, job skills, and experience required to achieve that pathway.

(2) The student knows electrical safety regulations and safety guidelines. The student is expected to:

(A) demonstrate safe working procedures during building maintenance;

(B) explain the purpose of the OSHA and how to promote safety on site;

(C) identify electrical hazards and how to avoid or minimize them on site; and

(D) explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

(3) The student knows how to interpret electrical drawings, electrical symbols, schematics, one-line diagrams, and wiring diagrams. The student is expected to:

(A) explain the basic layout of an electrical drawing;

(B) identify the common symbols used on electrical drawings;

(C) read equipment schedules found on electrical drawings; and

(D) describe the type of information included in electrical specifications.

Skip to main content

(4) The student knows how to handle fuses and circuit breakers. The student is expected to:

(A) explain the necessity of overcurrent protection devices in electrical circuits;

(B) define the terms associated with fuses and circuit breakers;

(C) describe the operation of a circuit breaker;

(D) describe the operation of single-element and time-delay fuses;

(E) explain how ground fault circuit interrupters can save lives; and

(F) describe troubleshooting and maintenance techniques for overcurrent devices.

(5) The student installs various types of lamps and fixtures. The student is expected to:

(A) recognize the different kinds of lamps and explain the advantages and disadvantages of each type, including incandescent, halogen, fluorescent, and high-intensity discharge;

(B) properly select and install lamps into lighting fixtures; and

(C) install various lighting fixtures, including surface mounted, recessed, suspended, and track-mounted.

(6) The student knows various methods to properly select, inspect, use, and maintain common electrical test equipment. The student is expected to:

(A) explain the operation of and describe various test equipment such as ammeter, voltmeter, ohmmeter, volt-ohm-multimeter, wattmeter, megohmmeter, frequency meter, power factor meter, continuity tester, voltage tester, recording instruments, and cable-length meters;

(B) explain how to read and convert from one scale to another using test equipment;

(C) explain the importance of proper meter polarity;

(D) define frequency and explain the use of a frequency meter; and

(E) explain the differences between digital and analog meters.

(7) The student installs and maintains electrical devices and knows wiring techniques common to commercial and industrial facilities. The student is expected to:

(A) describe how to determine electrical service requirements for commercial and industrial facilities;

(B) select the proper wiring methods for various commercial and industrial facilities;

(C) explain the role of the National Electrical Code;

(D) compute branch circuit loads and explain their installation requirements;

(E) explain the types and purposes of equipment grounding conductors;

(F) size and select outlet boxes for various wiring methods;

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(G) describe the rules for installing electric space heating and HVAC systems equipment; and

(H) describe the installation rules for electrical systems around swimming pools, spas, and hot tubs.

(8) The student is introduced to the basic principles of HVAC systems. The student is expected to:

(A) explain the principles of HVAC;

(B) describe what the Clean Air Act means to the HVAC systems industry; and

(C) identify the types of schedules and drawings used in HVAC systems and refrigeration industries.

(9) The student installs, selects, prepares, joins, and supports copper and plastic piping and fittings. The student is expected to:

(A) describe the precautions that must be taken when installing refrigerant piping;

(B) select the right tubing for a project;

(C) cut and bend copper tubing;

(D) determine the kinds of hangers and supports needed for refrigerant piping;

(E) describe the requirements for pressure-testing a system once it has been installed;

(F) identify types of plastic pipe and describe their uses; and

(G) cut and join lengths of plastic pipe.

(10) The student operates, tests, and adjusts conventional and electronic thermostats as well as the operation of common electrical, electronic, and pneumatic circuits used to control HVAC systems. The student is expected to:

(A) describe how conventional and electronic thermostats operate;

(B) describe how pneumatic and electronic circuits are used to control mechanical systems;

(C) analyze circuit diagrams for electronic and microprocessor-based controls; and

(D) troubleshoot systems using various controls.

(11) The student knows the concepts of historic preservation and local and national resources to maintain and renovate historic structures and landscapes. The student is expected to:

(A) research the United States Department of Interiors methods and guides for historic preservation;

(B) describe the rules and regulations for historic preservation as prescribed by the Texas Historical Commission; and

(C) describe the building codes regarding historic preservation for a local area.

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Electrical Technology

(1) The student identifies various employment opportunities in the field of electrical trades. The student is expected to:

(A) identify job opportunities with their accompanying job duties such as electrician, building maintenance technician, manager, and electrical engineer; and

(B) research career pathways along with the education, job skills, and experience required to achieve that pathway.

(2) The student identifies the issues associated with electrical hazards found on a job site. The student is expected to:

(A) demonstrate safe working procedures in a construction environment;

(B) explain the purpose of the Occupational Safety and Health Administration and how it promotes safety on the job;

(C) identify electrical hazards and how to avoid or minimize them in the workplace; and

(D) explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

(3) The student learns conduit bending and installation. The student is expected to:

(A) identify the methods of hand bending conduit;

(B) identify the various methods used to install conduit;

(C) use mathematical formulas to determine conduit bends;

(D) make 90 degree bends, back-to-back bends, offsets, kicks, and saddle bends using a hand bender; and

(E) cut, ream, and thread conduit.

(4) The student gains knowledge of the hardware and systems used by an electrician to mount and support boxes, receptacles, and other electrical components. The student is expected to:

(A) identify and explain the use of threaded fasteners;

(B) identify and explain the use of non-threaded fasteners;

(C) identify and explain the use of anchors;

(D) demonstrate the correct applications for fasteners and anchors; and

(E) install fasteners and anchors.

(5) The student learns the electrical concepts used in Ohm's law applied to direct current and series circuits. The student understands series parallel circuits, resistive circuits, Kirchhoff's voltage and current laws, and circuit analysis. The student is expected to:

(A) recognize what atoms are and how atoms are constructed;

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(B) define voltage and identify the ways in which it can be produced;

(C) explain the difference between conductors and insulators;

(D) define the units of measurement used to measure the properties of electricity;

(E) explain how voltage, current, and resistance are related to each other;

(F) calculate an unknown value using the formula for Ohm's law;

(G) explain the different types of meters used to measure voltage, current, and resistance;

(H) calculate the amount of power used by a circuit using the power formula;

(I) explain the basic characteristics of a series circuit;

(J) explain the basic characteristics of a parallel circuit;

(K) explain the basic characteristics of a series-parallel circuit;

(L) calculate, using Kirchhoff's current law, the total current in parallel and series-parallel circuits;

(M) find the total amount of resistance in a series circuit;

(N) find the total amount of resistance in a parallel circuit; and

(O) find the total amount of resistance in a series-parallel circuit.

(6) The student gains knowledge to properly select, inspect, use, and maintain common electrical test equipment. The student is expect to:

(A) explain the operation of test equipment such as ammeter, voltmeter, ohmmeter, volt-ohm-multimeter, wattmeter, megohmmeter, frequency meter, power factor meter, continuity tester, voltage tester, recording instruments, and cable-length meters;

(B) explain how to read and convert from one scale to another using the test equipment specified in subparagraph (A) of this paragraph;

(C) explain the importance of proper meter polarity;

(D) define frequency and explain the use of a frequency meter; and

(E) explain the difference between digital and analog meters.

(7) The student uses the National Electrical Code. The student is expected to:

(A) explain the purpose and history of the National Electrical Code;

(B) describe the layout of the National Electrical Code;

(C) explain how to navigate the National Electrical Code;

(D) describe the purpose of the National Electrical Manufacturers Association and National Fire Protection Association; and

(E) explain the role of testing laboratories.

(8) The student learns the types and applications of raceways, wireways, and ducts. The student is expected to:

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(A) describe various types of cable trays and raceways;

(B) identify and select various types and sizes of raceways;

(C) identify and select various types and sizes of cable raceways;

(D) identify and select various types of raceway fittings;

(E) identify various methods used to install raceways;

(F) demonstrate knowledge of National Electrical Code raceway requirements;

(G) describe procedures for installing raceways and boxes on masonry surfaces, metal stud systems, wood-framed systems, and drywall surfaces; and

(H) recognize safety precautions that must be followed when working with boxes and raceways.

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(9) The student learns the types and applications of conductors and wiring techniques. The student is expected to:

(A) explain the various sizes and gauges of wire in accordance with American Wire Gauge standards;

(B) identify insulation and jacket types according to conditions and applications;

(C) describe voltage ratings of conductors and cables;

(D) read and identify markings on conductors and cables;

(E) use the tables in the National Electrical Code to determine the ampacity of a conductor;

(F) state the purpose of stranded wire;

(G) state the purpose of compressed conductors;

(H) describe the different materials from which conductors are made;

(I) describe the different types of conductor insulation;

(J) describe the color coding of insulation;

(K) describe instrumentation control wiring;

(L) describe the equipment required for pulling wire through conduit;

(M) describe the procedure for pulling wire through conduit;

(N) install conductors in conduit; and

(O) pull conductors in a conduit system.

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(10) The student learns electrical symbols and their use in design drawings. Additionally, students learn to interpret schematics, one-line diagrams, and wiring diagrams. The student is expected to:

(A) explain the basic layout of a design drawing;

(B) describe the information included in the title block of a drawing;

(C) identify the types of lines used on drawings;

(D) identify common symbols used on drawings;

(E) understand the use of architect's and engineer's scales;

Skip to main content

(F) interpret electrical drawings, including site plans, floor plans, and detail drawings;

(G) read equipment schedules found on electrical drawings; and

(H) describe the type of information included in electrical specifications.

(11) The student learns the electrical devices and wiring techniques used in commercial and industrial construction and maintenance. The student is expected to:

(A) identify and state the functions and ratings of single-pole, double-pole, three-way, four-way, dimmer, special, and safety switches;

(B) explain National Electrical Manufacturers Association classifications as they relate to switches and enclosures;

(C) explain the National Building Code requirements concerning wiring devices;

(D) identify and state the functions and ratings of straight blade, twist lock, and pin and sleeve receptacles;

(E) identify and define receptacle terminals and disconnects;

(F) identify and define ground fault circuit interrupters;

(G) explain the box mounting requirements in the National Building Code;

(H) use a wire stripper to strip insulation from a wire;

(I) use a solderless connector to splice wires together;

(J) identify and state the functions of limit switches and relays; and

(K) identify and state the function of switchgear.

(12) The student learns the electrical devices and wiring techniques used in residential construction maintenance. The student is expected to:

(A) describe how to determine electric service requirements for dwellings;

(B) explain the grounding requirements of a residential electric service;

(C) calculate and select service-entrance equipment;

(D) select the proper wiring methods for various types of residences;

(E) explain the role of the National Electrical Code in residential wiring;

(F) compute branch circuit loads and explain their installation requirements;

(G) explain the types and purposes of equipment grounding conductors;

(H) explain the purpose of ground-fault circuit interrupters and tell where they must be installed;

(I) size outlet boxes and select the proper type for different wiring methods;

(J) describe rules for installing electric space heating and heating, ventilating, and air conditioning equipment;

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(K) describe the installation rules for electrical systems around swimming pools, spas, and hot tubs;

(L) describe the installation and control of lighting fixtures; and

(M) explain how wiring devices are selected and installed.

Advanced Electrical Technology

(1) The student identifies various employment opportunities in the field of electrical trades. The student is expected to:

(A) identify job opportunities with their accompanying job duties such as electrician, building maintenance technician, manager, and electrical engineer; and

(B) research careers along with the education, job skills, and experience required to achieve that career goal.

(2) The student knows the issues associated with electrical hazards found on a job site. The student is expected to:

(A) demonstrate safe working procedures in a construction environment;

(B) explain the purpose of the Occupational Safety and Health Administration and how it promotes safety on the job;

(C) identify electrical hazards and how to avoid or minimize them in the workplace; and

(D) explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection.

(3) The student learns characteristics of alternating-current systems and the application of Ohm's law to alternating current circuits. The student is expected to:

(A) calculate the peak and effective voltage or current values for an alternating current waveform;

(B) calculate the phase relationship between two alternating current waveforms;

(C) describe the voltage and current phase relationship in a resistive alternating current circuit;

(D) describe the voltage and current transients that occur in an inductive circuit;

(E) define inductive reactance and state how it is affected by frequency;

(F) define the voltage and current transients that occur in a capacitive circuit;

(G) define capacitive reactance and state how it is affected by frequency;

(H) explain the relationship between voltage and current in alternating current circuits such as resistor-inductor circuit, resistor-capacitor circuit, LC circuit, and RLC circuit;

(I) describe the effect that resonant frequency has on impedance and current flow in a series or parallel resonant circuit;

(J) define bandwidth and describe how it is affected by resistance in a series or parallel resonant circuit; and

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(K) explain terms such as true power, apparent power, reactive power, power factor, and basic transformer action as related to alternating current circuits.

(4) The student gains knowledge of alternating current and direct current motors with specific attention being given to main parts, circuits, and connections. The student is expected to:

(A) define terms such as ampacity, branch circuit, circuit breaker, controller, duty, full-load amps, ground fault circuit interrupter, interrupting rating, motor circuit switch, thermal protector, National Electrical Manufacturers Association design letter, non-automatic, overcurrent, overload, rated full-load speed, rated horsepower, remote control circuit, service factor, and thermal cutout;

(B) describe the various types of motor enclosures;

(C) describe how the rated voltage of a motor differs from the system voltage;

(D) describe the basic construction and components of a three-phase squirrel cage induction motor;

(E) explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor;

(F) describe how torque is developed in an induction motor;

(G) explain how and why torque varies with rotor reactance and slip;

(H) define percent slip and speed regulation;

(I) explain how the direction of a three-phase motor is reversed;

(J) describe the component parts and operating characteristics of a three-phase wound-rotor induction motor;

(K) define torque, starting current, and armature reaction as they apply to direct current motors;

(L) explain how the direction of rotation of a direct current motor is changed;

(M) describe the design and characteristics of direct current shunt, series, and compound motor;

(N) describe dual-voltage motors and their applications;

(O) describe the methods for determining various motor connections; and

(P) describe general motor protection requirements as delineated by the National Electrical Code.

(5) The student learns the purpose for grounding and bonding electrical systems. The student is expected to:

(A) explain the purpose of grounding and the scope of the National Electrical Code;

(B) distinguish between a short circuit and a ground fault;

(C) define the National Electrical Code ground-related terms;

(D) distinguish between system grounding and equipment grounding;

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(E) use the National Electrical Code to size the grounding electrode conductor for various alternating current systems;

(F) explain the National Electrical Code requirements for the installation and physical protection of grounding electrode conductors;

(G) explain the function of the grounding electrode system and determine which grounding electrodes must be used;

(H) define electrodes and explain the resistance requirements for electrodes using the National Electrical Code;

(I) use the National Electrical Code to size the equipment grounding conductor for raceways and equipment;

(J) explain the function of the main bonding jumper and system bonding jumpers in the grounding system and size the bonding jumpers for various applications;

(K) size the main bonding jumper for a service using multiple service disconnecting means;

(L) explain the National Electrical Code requirements for bonding of enclosures and equipment;

(M) explain effective grounding and its importance in clearing ground faults and short circuits;

(N) explain the purposes of the grounded conductor neutral in operation of overcurrent devices;

(O) explain the National Electrical Code requirements for grounding separately derived systems, including transformers and generators;

(P) explain the National Electrical Code requirements for grounding at more than one building; and

(Q) explain the National Electrical Code grounding requirements for systems over 600 volts.

(6) The student properly bends all sizes of conduit up to six inches. The student is expected to:

(A) describe the process of conduit bending using power tools;

(B) identify all parts of popular electric and hydraulic benders;

(C) avoid excessive waste when working with conduit systems;

(D) bend offsets, kicks, saddles, and segmented and parallel bends;

(E) explain the requirements for the National Electrical Code for bending conduit;

(F) compute the radius, degrees in bend, developed length, and gain for conduit up to six inches; and

(G) explain how to correct damaged conduit and modify existing bends.

(7) The student learns to select and size outlet boxes, pull boxes, and junction boxes. The student is expected to:

Skip to main content

(A) describe the different types of nonmetallic and metallic boxes;

(B) calculate the required box size for any number and size of conductors;

(C) explain the National Electrical Code regulations for volume required per conductor in outlet boxes;

(D) properly locate, install, and support boxes of all types;

(E) describe the National Electrical Code regulations governing pull and junction boxes;

(F) explain the radius rule when installing conductors in pull boxes;

(G) understand the National Electrical Code requirements for boxes supporting lighting fixtures;

(H) describe the purpose of conduit bodies and Type FS boxes;

(I) install the different types of fittings used in conjunction with boxes;

(J) describe the installation rules for boxes and fittings in hazardous areas;

(K) explain how boxes and fittings are selected and installed; and

(L) describe the various types of box supports.

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(8) The student knows transportation, storage, and setup of cable reels, methods of rigging, and procedures to complete cable pulls in raceways and cable trays. The student is expected to:

(A) describe the various methods of installing conductors in conduit;

(B) plan and set up for a cable pull;

(C) describe how cable reels are transported to the pulling site;

(D) set up reel stands and spindles for a wire-pulling installation;

(E) explain how mandrels, swabs, and brushes are used to prepare conduit for conductors;

(F) properly install a pull line for a cable-pulling operation;

(G) explain the operation of power fish tape systems;

(H) prepare the ends of conductors for pulling;

(I) describe the types of cable pullers;

(J) describe the process of high-force cable pulling;

(K) explain how to support conductors in vertical conduit runs;

(L) describe the installation of cables in cable trays;

(M) explain the importance of communication during a cable-pulling operation; and

(N) calculate the probable stress or tension in cable pulls.

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(9) The student installs cable trays and modifies cable trays and cable. The student is expected to:

Skip to main content

(A) describe the components that make up a cable tray assembly;

(B) explain the methods used to hang and secure a cable tray;

(C) describe how cable enters and exits cable trays;

(D) select the proper cable tray fitting for the situation;

(E) explain the National Electrical Manufacturers Association standards for cable tray installations;

(F) explain the National Electrical Code requirements for cable tray installations;

(G) select the required fittings to ensure equipment grounding continuity in cable tray systems;

(H) interpret electrical working drawings showing cable tray fittings;

(I) size a cable tray for the number and type of conductors contained in the system;

(J) select rollers and sheaves for pulling cable in specific cable tray situations; and

(K) designate the required locations of rollers and sheaves for a specific cable pull.

(10) The student knows the methods of terminating and splicing conductors of all types and sizes and the preparation and taping of conductors. The student is expected to:

(A) describe how to make a good conductor termination;

(B) prepare cable ends for terminations and splices;

(C) install lugs and connector onto conductors;

(D) train cable at termination points;

(E) explain the role of the National Electrical Code in making cable terminations and splices;

(F) explain why mechanical stress should be avoided at cable termination points;

(G) describe the importance of using proper bolt torque when bolting lugs onto bus bars;

(H) describe crimping techniques;

(I) select the proper lug or connector for the job;

(J) describe splicing techniques; and

(K) explain how to use hand and power crimping tools.

(11) The student installs single- and three-phase services, including metering equipment. The student is expected to:

(A) describe various types of electric services for commercial and industrial installations;

(B) read electrical drawings and diagrams describing service installation;

(C) calculate and select service-entrance equipment;

(D) explain the role of the National Electrical Code in service installations;

(E) install main disconnect switches, panel boards, and overcurrent protection devices;

Skip to main content

(F) identify the circuit loads, number of circuits required, and installation requirements for distribution panels;

(G) explain the types and purposes of service grounding;

(H) explain the purpose and required locations of ground fault circuit interrupters;

(I) describe single-phase service connections; and

(J) describe both wye-phase and delta-connected three-phase services.

(12) The student knows the practical application of fuses and circuit breakers. The student is expected to:

(A) explain the necessity of overcurrent protection devices in electrical circuits;

(B) define the terms associated with fuses and circuit breakers;

(C) describe the operation of a circuit breaker;

(D) select the most suitable overcurrent device for the application;

(E) describe the operation of single-element and time-delay fuses;

(F) explain how ground fault circuit interrupters can save lives;

(G) calculate short circuit currents; and

(H) describe troubleshooting and maintenance techniques for overcurrent devices.

(13) The student knows the practical applications of contactors and relays. The student is expected to:

(A) describe the operating principles of contactors and relays;

(B) select contactors and relays for use in specific electrical systems;

(C) explain how mechanical contactors operate;

(D) explain how solid-state contactors operate;

(E) install contactors and relays according to National Electrical Code requirements;

(F) select and install contactors and relays for lighting control;

(G) describe how overload relays operate;

(H) connect a simple control circuit; and

(I) test control circuits.

(14) The student learns the basic principles of human vision and the characteristics of light. The student is expected to:

(A) explain how the human eye works;

(B) describe the characteristics of light;

(C) recognize the different kinds of lamps and explain the advantages and disadvantages of each type, including incandescent, halogen, fluorescent, and high-intensity discharge;

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(D) properly select and install lamps into lighting fixtures; and

(E) recognize and install various types of lighting fixtures, including surface mounted, recessed, suspended, and track-mounted units.

Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology

(1) The student identifies various employment opportunities in the field of HVAC and refrigeration industries. The student is expected to:

(A) identify job opportunities with their accompanying job duties in occupations such as electrician, building maintenance technician, manager, and electrical engineer; and

(B) research career pathways along with the education, job skills, and experience required to achieve that career goal.

(2) The student learns the basic principles of HVAC and refrigeration. The student is expected to:

(A) explain the basic principles of HVAC;

(B) describe what the Clean Air Act means to the HVAC and refrigeration industry; and

(C) identify the types of schedules and drawings used by the HVAC and refrigeration industry.

(3) The student applies the knowledge and skills in mathematics that are particular to HVAC and refrigeration. The student is expected to:

(A) identify similar units of measurement in both English and the International System (SI) of units and state which units are larger;

(B) convert measured values in the English system to equivalent SI values and vice versa;

(C) express numbers as powers of ten;

(D) determine the powers and roots of numbers;

(E) solve basic algebraic equations;

(F) identify various geometric figures;

(G) use the Pythagorean Theorem to make calculations involving right triangles;

(H) calculate perimeter, area, and volume; and

(I) convert temperature values between Celsius and Fahrenheit.

(4) The student selects, prepares, joins, and supports copper and plastic piping and fittings. The student is expected to:

(A) state the precautions that must be taken when installing refrigerant piping;

(B) select the right tubing for a job;

(C) cut and bend copper tubing;

(D) safely join tubing by using flare and compression fittings;

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(E) determine the kinds of hangers and supports needed for refrigerant piping;

(F) describe the basic requirements for pressure-testing a system once it has been installed;

(G) identify types of plastic pipe and state their uses; and

(H) cut and join lengths of plastic pipe.

(5) The student cuts, threads, and joins ferrous piping. The student is expected to:

(A) assemble and operate the tools used for soldering;

(B) prepare tubing and fittings for soldering;

(C) identify the purposes and uses of solder and solder fluxes;

(D) solder copper tubing fittings;

(E) assemble and operate the tools used for brazing;

(F) prepare tubing and fittings for brazing;

(G) identify the purposes and uses of filler metals and fluxes used for brazing;

(H) braze copper tubing and fittings;

(I) identify the inert gases that can be used safely to purge tubing when brazing;

(J) identify the types of ferrous metal pipes;

(K) accurately measure the sizes of ferrous metal pipes;

(L) identify the common malleable iron fittings;

(M) cut, ream, and thread ferrous metal pipe;

(N) join lengths of threaded pipe together and install fittings;

(O) describe the main points to consider when installing pipe runs; and

(P) describe the methods used to join grooved piping.

(6) The student knows electrical principles, power generation and distribution, electrical components, direct current circuits, and electrical safety. The student is expected to:

(A) explain how electrical power is distributed;

(B) describe how voltage, current, resistance, and power are related;

(C) use Ohm's law to calculate the current, voltage, and resistance in a circuit;

(D) use the power formula to calculate how much power is consumed by a circuit;

(E) describe the differences between series and parallel circuits and calculate loads in each;

(F) describe the purpose and operation of the various electrical components used in HVAC equipment;

(G) state and demonstrate the safety precautions that must be followed when working on electrical equipment;

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(H) make voltage, current, and resistance measurements using electrical test equipment; and

(I) read and interpret common electrical symbols.

(7) The student learns the principles of heat transfer, refrigeration, pressure temperature relationships, and the components and accessories used in air conditioning systems. The student is expected to:

(A) explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle;

(B) calculate the temperature and pressure relationships at key points in the refrigeration cycle;

(C) under supervision, use temperature- and pressure-measuring instruments to make readings at key points in the refrigeration cycle;

(D) identify commonly used refrigerants and demonstrate the procedures for handling these refrigerants;

(E) identify the major components of a cooling system and explain how each type works;

(F) identify the major accessories available for cooling systems and explain how each works;

(G) identify the control devices used in cooling systems and explain how each works; and

(H) demonstrate the correct methods to be used when piping a refrigeration system.

(8) The student learns heating fundamentals, types and designs of furnaces and their components, and basic procedures for installing and servicing furnaces. The student is expected to:

(A) explain the three methods by which heat is transferred and give an example of each;

(B) describe how combustion occurs and identify the by-products of combustion;

(C) identify the various types of fuels used in heating;

(D) identify the major components and accessories of an induced draft and condensing gas furnace and explain the function of each component;

(E) describe the factors that must be considered when installing a furnace;

(F) identify the major components of a gas furnace and describe how each works;

(G) with supervision, use a manometer to measure and adjust manifold pressure on a gas furnace;

(H) identify the major components of an oil furnace and describe how each works; and

(I) with supervision, perform furnace preventive maintenance procedures such as cleaning and filter replacement.

(9) The student gains knowledge and skills related to air distribution systems. The student is expected to:

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(A) describe the airflow and pressures in a basic forced-air distribution system;

(B) explain the differences between propeller and centrifugal fans and blowers;

(C) identify the various types of duct systems and explain why and where each type is used;

(D) demonstrate or explain the installation of metal, fiberboard, and flexible duct;

(E) demonstrate or explain the installation of fittings and transitions used in duct systems;

(F) demonstrate or explain the use and installation of diffusers, registers, and grilles used in duct systems;

(G) demonstrate or explain the use and installation of dampers used in duct systems;

(H) demonstrate or explain the use and installation of insulation and vapor barriers used in duct systems;

(I) identify the instruments used to make measurements in air systems and explain the use of each instrument; and

(J) make accurate temperature, air pressure, and velocity measurements in an air distribution system.

Advanced Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology

(1) The student learns the systems, equipment, and operating sequences used in a variety of commercial airside system configurations such as constant volume single-zone and multi-zone, variable valve timing, variable air volume, and dual-duct variable air volume. The student is expected to:

(A) identify the differences between types of commercial air systems;

(B) identify the type of building in which a particular type of system is used; and

(C) explain the typical range of capacities for a commercial air system.

(2) The student knows the principles of venting fossil-fuel furnaces and the proper methods for selecting and installing vent systems for gas-fired heating equipment. The student is expected to:

(A) describe the principles of combustion and explain complete and incomplete combustion;

(B) describe the content of flue gas and explain how it is vented;

(C) identify the components of a furnace vent system;

(D) describe how to select and install a vent system;

(E) perform the adjustments necessary to achieve proper combustion in a gas furnace;

(F) describe the techniques for venting different types of furnaces;

(G) explain the various draft control devices used with natural-draft furnaces;

(H) calculate the size of a vent required for a given application; and

(I) adjust a thermostat heat anticipator.

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(3) **The student gains knowledge of hot water heating systems, focusing on safe operation of the low-pressure boiler and piping systems commonly used in residential applications. The student is expected to:**

(A) explain the terms and concepts used when working with hot-water heating;

(B) identify the major components of hot-water heating;

(C) explain the purpose of each component of hot-water heating;

(D) demonstrate the safety precautions used when working with hot-water systems;

(E) demonstrate how to operate selected hot-water systems;

(F) demonstrate how to safely perform selected operating procedures on low-pressure systems;

(G) identify the common piping configurations used with hot-water heating;

(H) explain how to read the pressure across a water system circulating pump;

(I) calculate heating water flow rates; and

(J) select a pump for a given application.

(4) **The student learns the basic principles, processes, and devices used to control humidity and air clean-lines as well as devices used to conserve energy in HVAC systems. The student is expected to:**

(A) explain why it is important to control humidity in a building;

(B) recognize the various kinds of humidifiers used with HVAC systems and explain why each is used;

(C) demonstrate how to install and service the humidifiers used in HVAC systems;

(D) recognize the kinds of air filters used with HVAC systems and explain why each is used;

(E) demonstrate how to install and service the filters used in HVAC systems;

(F) use a manometer or differential pressure gauge to measure the friction loss of an air filter;

(G) identify accessories commonly used with air conditioning systems to improve indoor air quality and reduce energy cost and explain the function of each, including humidity control devices, air filtration devices, and energy conservation devices; and

(H) demonstrate or describe how to clean an electronic air cleaner.

(5) **The student gains the knowledge and skills in the handling of refrigerant and equipment servicing procedures to service HVAC systems in an environmentally safe manner. The student is expected to:**

(A) identify the common types of leak detectors and explain how each is used;

(B) perform leak detection tests using selected methods;

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(C) identify the service equipment used for evacuating a system and explain why each item of equipment is used;

(D) perform system evacuation and dehydration;

(E) identify the service equipment used for recovering refrigerant from a system and for recycling the recovered refrigerant and explain why each item of equipment is used;

(F) perform a refrigerant recovery;

(G) evacuate a system to a deep vacuum;

(H) identify the service equipment used for charging refrigerant into a system and explain why each item of equipment is used;

(I) use nitrogen to purge a system; and

(J) charge refrigerant into a system using various methods, including weight, superheat, sub-cooling, and charging pressure chart.

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(6) The student gains knowledge of transformers, single-phase and three-phase power distribution, capacitors, theory and operation of induction motors, and instruments and techniques used in testing alternating current circuits and components. The student is expected to:

(A) describe the operation of various types of transformers;

(B) explain how alternating current is developed and draw a sine wave;

(C) identify single-phase and three-phase wiring arrangements;

(D) explain how phase shift occurs in inductors and capacitors;

(E) describe the types of capacitors and their applications;

(F) explain the operation of single-phase and three-phase induction motors;

(G) identify the various types of single-phase motors and their applications;

(H) state and demonstrate the safety precautions that must be followed when working with electrical equipment; and

(I) test alternating current components, including, capacitors, transformers, and motors.

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(7) The student learns the theory of solid-state electronics as well as the operation, use, and testing of the various electronic components used in HVAC equipment. The student is expected to:

(A) explain the theory of electronics and semiconductors;

(B) explain how various semiconductor devices such as diodes, light emitting diodes, and photo diodes work and how the devices are used in power and control circuits;

(C) identify different types of resistors and explain how their resistance values can be determined;

(D) describe the operation and function of thermistors and cad cells;

(E) test semiconductor components; and

(F) identify the connectors on a personal computer.

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(8) The student learns the operation, testing, and adjustment of conventional and electronic thermostats as well as the operation of common electrical, electronic, and pneumatic circuits used to control HVAC systems. The student is expected to:

(A) explain the function of a thermostat in an HVAC system;

(B) describe different types of thermostats and explain how the thermostats are used;

(C) demonstrate the correct installation and adjustment of a thermostat;

(D) explain the principles applicable to all control systems;

(E) identify the various types of electromechanical, electronic, and pneumatic HVAC controls and explain their function and operation;

(F) describe a systematic approach for electrical troubleshooting of HVAC equipment and components;

(G) recognize and use equipment manufacturers' troubleshooting aids to troubleshoot HVAC equipment;

(H) demonstrate how to isolate electrical problems to faulty power distribution, load, or control circuits;

(I) identify the service instruments needed to troubleshoot HVAC electrical equipment;

(J) make electrical troubleshooting checks and measurements on circuits and components common to all HVAC equipment; and

(K) isolate and correct malfunctions in a cooling system control circuit.

(9) The student learns the tools, instruments, and techniques used in troubleshooting gas heating appliances, including how to isolate and correct faults. The student is expected to:

(A) describe the operating sequence for gas heating equipment;

(B) interpret control circuit diagrams for gas heating systems;

(C) describe the operation of various types of burner ignition methods;

(D) identify the tools and instruments used when troubleshooting gas heating systems;

(E) demonstrate using the tools and instruments required for troubleshooting gas heating systems; and

(F) isolate and correct malfunctions in gas heating systems.

(10) The student learns the techniques and equipment used in troubleshooting cooling equipment and analyzing system temperatures and pressures in order to isolate faults. The student is expected to:

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(A) describe a systematic approach for troubleshooting cooling systems and components;

(B) isolate problems to electrical and mechanical functions in cooling systems;

(C) recognize and use equipment manufacturers' troubleshooting aids to troubleshoot cooling systems;

(D) identify and use the service instruments needed to troubleshoot cooling systems;

(E) successfully troubleshoot selected problems in cooling equipment; and

(F) state the safety precautions associated with cooling troubleshooting.

(11) The student learns the principles of reverse cycle heating, the operation of various types of heat pumps, and how to analyze heat pump control circuits. The student learns to install and service heat pumps. The student is expected to:

(A) describe the principles of reverse-cycle heating;

(B) identify heat pumps by type and general classification;

(C) describe various types of geothermal water loops and their application;

(D) list the components of heat pump systems;

(E) describe the role and operation of electric heat in common heat pump systems;

(F) describe common heat pump ratings such as Coefficient of Performance, Heating Season Performance Factor, and Seasonal Energy Efficiency Ratio;

(G) demonstrate heat pump installation and service procedures;

(H) identify and install refrigerant circuit accessories commonly associated with heat pumps;

(I) analyze a heat pump control circuit; and

(J) isolate and correct malfunctions in a heat pump.

(12) The student selects the application and installation of various types of fasteners, gaskets, seals, and lubricants as well as the installation and adjustment of different types of belt drives, bearings, and couplings. The student is expected to:

(A) identify, explain, and install threaded and non-threaded fasteners;

(B) identify, remove, and install types of gaskets, packings, and seals;

(C) identify types of lubricants and explain their uses;

(D) use lubrication equipment to lubricate motor bearings;

(E) identify the types of belt drives, explain their uses, and demonstrate procedures used to install or adjust them;

(F) identify and explain types of couplings;

(G) demonstrate procedures used to remove, install, and align couplings;

(H) identify types of bearings and explain their uses;

(I) explain causes of bearing failures;

(J) demonstrate procedures used to remove and install bearings;

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(K) perform preventive maintenance inspection and cleaning procedures; and

(L) list ways to develop and maintain good customer relations.

(13) The student demonstrates how to lay out, fabricate, install, and join sheet metal ductwork. The student is expected to:

(A) identify and describe the types of sheet metal;

(B) define properties of steel and aluminum alloys;

(C) describe a layout method and perform proper cutting;

(D) join sheet metal duct sections using proper seams and connectors;

(E) describe proper hanging and support methods for sheet metal ductwork;

(F) describe thermal and acoustic insulation principles;

(G) select, apply, and seal the proper insulation for sheet metal ductwork;

(H) describe guidelines for installing components such as register, diffusers, grilles, dampers, access doors, and zoning accessories; and

(I) install takeoffs and attach flexible duct to a sheet metal duct.

(14) The student gains the knowledge and skills to lay out, fabricate, install, join, attach, and support fiberglass ductwork and fittings. The student is expected to:

(A) identify types of fiberglass duct, including flexible duct;

(B) describe fiberglass duct layout and some basic fabrication methods;

(C) describe the various closure methods for sealing fiberglass duct;

(D) fabricate selected duct modules and fittings using the appropriate tools;

(F) describe how to repair major and minor damage to fiberglass duct; and

(E) describe hanging and support methods for fiberglass duct;

(G) install takeoffs and attach flexible duct to a fiberglass duct.

Piping and Plumbing Technology

(1) The student identifies various employment opportunities in the fields of plumbing and pipe fitting. The student is expected to:

(A) identify job opportunities with their accompanying job duties such as plumber, pipe fitter, building maintenance technician or supervisor, manager, and mechanical engineer;

(B) research careers along with the education, job skills, and experience required to achieve that career goal; and

(C) identify the industries and associations that make up the modern plumbing and pipe fitting profession.

(2) The student understands the causes of accidents and their consequences and repercussions in terms of delays, increased expenses, injury, and loss of life. The student is expected to:

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(A) describe the common unsafe acts and unsafe conditions that cause accidents;

(B) describe how to handle unsafe acts and unsafe conditions;

(C) explain the impact and cost of accidents and illnesses;

(D) demonstrate the use and care of appropriate personal protective equipment;

(E) identify job-site hazards specific to plumbers;

(F) demonstrate the proper use of ladders;

(G) explain how to work around a trench; and

(H) describe and demonstrate the lockout and tagout process.

(3) The student selects and properly uses different types of hand and power tools related to a specific task. The student is expected to:

(A) identify the hand and power tools used in the plumbing industry;

(B) demonstrate the proper use of plumbing tools;

(C) demonstrate the ability to know when and how to select the proper tools for tasks;

(D) demonstrate proper maintenance and care for hand and power tools;

(E) demonstrate how to prepare a surface for tool use; and

(F) describe the safety requirements for using plumbing tools.

(4) The student applies mathematics concepts such as whole numbers, fractions, decimals, and squares and examines how these apply to specific situations. The student is expected to:

(A) add, subtract, multiply, and divide whole numbers, fractions, and decimals;

(B) convert fractions to decimals and decimals to fractions;

(C) demonstrate the metric system and how it is used in the plumbing industry;

(D) square various numbers and determine the square roots of numbers, with and without a calculator;

(E) identify the parts of a fitting and use common pipe-measuring techniques;

(F) use fitting dimensions tables to determine fitting allowances and thread makeup; and

(G) calculate end-to-end measurements using fitting allowances and thread makeup.

(5) The student learns the various types of drawings used in the plumbing industry to lay out and install plumbing systems. The student is expected to:

(A) identify pictorial, isometric and oblique, schematic, and orthographic drawings and discuss how different views are used to depict information about objects;

(B) identify the basic symbols used in schematic drawings of pipe assemblies;

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(C) explain the types of drawings that may be included in a set of plumbing drawings and the relationship among the different drawings;

(D) interpret plumbing-related information from a set of drawings;

(E) sketch orthographic and schematic drawings;

(F) use an architect's scale to draw lines to scale and to measure lines drawn to scale; and

(G) discuss how code requirements apply to certain drawings.

(6) The student learns the types and grades of plastic pipe and fittings used in plumbing applications, including acrylonitrile butadiene styrene, polyvinyl chloride, chlorinated polyvinyl chloride, polyethylene, crosslinked polyethylene, and polybutylene. The student is expected to:

(A) identify types of materials and schedules of plastic piping;

(B) identify proper and improper applications of plastic piping;

(C) identify types of fittings and valves used with plastic fittings;

(D) identify and determine the kinds of hangers and supports needed for plastic piping;

(E) identify the various techniques used in hanging and supporting plastic piping;

(F) properly measure, cut, and join plastic piping; and

(G) explain proper procedures for the handling, storage, and protection of plastic pipes.

(7) The student understands the applications of copper pipe and fittings and the types of valves that can be used on copper pipe systems and the methods for cutting, joining, and installing copper pipe. The student is expected to:

(A) identify the types of materials and schedules used with copper piping;

(B) identify the material properties, storage, and handling requirements of copper piping;

(C) identify the types of fittings and valves used with copper piping;

(D) identify the various techniques used in hanging and supporting copper piping;

(E) properly measure, ream, cut, and join copper piping; and

(F) identify the hazards and safety precautions associated with copper piping.

(8) The student measures, cuts, threads, joins, and hangs carbon steel pipe. The student becomes familiar with labeling and sizing of carbon steel pipe. The student is expected to:

(A) recognize proper applications of carbon steel piping;

(B) identify the material properties, storage, and handling requirements of carbon steel piping;

(C) identify the various techniques used in hanging and supporting carbon steel piping; and

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(D) properly measure, cut, groove, thread, and join steel piping.

(9) The student gains knowledge and skills to connect and install flexible plastic coated steel tubing in various installation conditions. The student is expected to:

(A) identify the common manufacturers of corrugated stainless steel tubing;

(B) recognize proper and improper applications of corrugated stainless steel tubing;

(C) identify the various techniques used in hanging and supporting corrugated stainless steel tubing;

(D) explain how to properly measure, cut, join, and groove corrugated stainless steel tubing; and

(E) identify the material properties, storage, and handling requirements of corrugated stainless steel tubing.

(10) The student learns the various plumbing fixtures, the materials they are comprised of, and their installation and use. The student is expected to:

(A) identify the types of materials used in the manufacture of plumbing fixtures;

(B) discuss common types of sinks, lavatories, and faucets;

(C) identify and discuss common types of bathtubs, bath-shower modules, shower stalls, and shower baths;

(D) discuss common types of toilets, urinals, and bidets;

(E) identify and describe common types of drinking fountains and water coolers; and

(F) discuss common types of garbage disposals and domestic dishwashers.

(11) The student learns the way drain, waste, and vent systems remove waste safely. The student learns how pipes, drains, traps, and vents work. The student is expected to:

(A) explain how waste moves from a fixture through the drain system to the environment;

(B) identify the major components of a drainage system and describe their functions;

(D) identify the various types of drain, waste, and vent fittings and describe their applications; and

(C) identify the different types of traps and their components, explain the importance of traps, and identify the ways that traps can lose their seals;

(E) identify significant code and health issues, violations, and consequences related to drain, waste, and vent systems.

(12) The student learns the principles of electricity, including voltage, current, resistance, power, electrical formulas, circuitry, and common plumbing-related electrical applications. The student is expected to:

(A) state and demonstrate the safety precautions that must be followed when working on electrical equipment;

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(B) describe how electrical power is generated and distributed;

(C) describe how voltage, current, resistance, and power are related;

(D) use Ohm's law to calculate the current, voltage, and resistance in a circuit;

(E) use the power formula to calculate how much power is consumed by a circuit;

(F) describe the differences between series and parallel circuits;

(G) recognize and describe the purpose and operation of the various electrical components used in plumbing equipment;

(H) make voltage, current, and resistance measurements using electrical test equipment;

(I) determine the positioning of leads;

(J) test a fuse for continuity; and

(K) explain and understand electrical symbols.

(13) The student gains the knowledge and skills to locate, install, and test complete water systems, including piping, meters, water heaters, water softeners, and hose bibs. The student is expected to:

(A) develop a material takeoff from a given set of plans;

(B) use plans and fixture rough-in sheets to determine the location of fixtures and the route of the water supply piping;

(C) locate and size a water meter;

(D) locate a water heater, water softener, and hose bib;

(E) install a water distribution system using appropriate hangers;

(F) modify structural members, using the appropriate tools, without weakening the structure;

(G) correctly size and install a water service line, including backflow prevention; and

(H) test a water supply system.

(14) The student gains the knowledge and skills for the safe handling and installation of natural gas, liquefied petroleum gas, and fuel oil systems. The student is expected to:

(A) identify the major components of the fuel systems of natural gas, liquefied petroleum gas, and fuel oil and describe the functions of each component;

(B) identify the safety precautions and potential hazards associated with each type of fuel and system, including natural gas, liquefied petroleum gas, and fuel oil;

(C) connect appliances to a fuel gas system properly;

(D) apply local codes to various fuel gas systems;

(E) design, size, purge, and test fuel gas systems; and

(F) demonstrate familiarity with applicable fuel gas codes.

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Advanced Piping and Plumbing Technology

(1) The student understands the selection, use, and maintenance of hand and power tools used by the pipe fitting industry. The student becomes familiar with tools, including pipe wrenches, pipe stands, pipe vises, levels, pipe fabrication tools, and pipe fitting tools. The student is expected to:

(A) describe the safety requirements that apply to the use of pipefitter hand and power tools;

(B) explain how to properly care for selected pipefitter hand and power tools;

(C) demonstrate how to safely and properly use selected pipefitter hand tools;

(D) identify tools and state their uses;

(E) use selected hand tools;

(F) cut pipe using a portable band saw;

(G) identify and explain the uses of portable grinders;

(H) explain the proper and safe operations of machines used in pipe joint preparations, including pipe threaders, portable power drives, and pipe bevellers; and

(I) perform selected pipe and joint preparation operations using power tools.

(2) The student gains the knowledge and skills for the safe use of oxyfuel cutting equipment. The student learns techniques for cutting straight lines, piecing, beveling, washing, and gouging materials. The student is expected to:

(A) identify and explain the use of oxyfuel cutting equipment;

(B) set up oxyfuel equipment;

(C) light and adjust an oxyfuel torch;

(D) shut down oxyfuel cutting equipment;

(E) disassemble oxyfuel equipment;

(F) change empty cylinders;

(G) perform oxyfuel cutting;

(H) perform straight line and square shape procedures;

(I) perform piercing and slot cutting operations;

(J) conduct bevel operations; and

(K) perform washing procedures.

(3) The student identifies the safety, operation, and maintenance of motorized equipment such as electrical generators, air compressors, aerial lifts, pumps, forklifts, and hydraulic cranes. The student is expected to:

(A) state the safety precautions associated with the use of motor-driven equipment used on job sites;

(B) identify and explain the operation and uses of equipment, including welding machines, portable generators, air compressors, portable pumps, aerial lifts, compaction equipment, forklifts, trenching equipment, and backhoes; and

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(C) perform pre-start checks and operate equipment, including portable generators, welding machines, portable pumps, and air compressors.

(4) The student learns chemical, compressed air, fuel oil, steam, and water systems and the methods of identifying piping systems according to color codes. The student is expected to:

(A) identify and explain the types of piping systems;

(B) explain the effects and corrective measures for thermal expansion in piping systems; and

(C) explain types and applications of pipe insulation.

(5) The student learns plot plans, structural design, shop drawings, elevation drawings, as-built drawings, equipment arrangement drawings, pipe and instrumentation drawings, isometric drawings, spool sheets, and detail drawings. The student is expected to:

(A) identify types of drawings;

(B) identify and use drawing symbols associated with piping plans and details;

(C) create field sketches; and

(D) interpret drawing indexes and line lists.

(6) The student installs, stores, and handles various types of valves. The student is expected to:

(A) identify types of valves that start and stop flow;

(B) identify types of valves that regulate flow;

(C) identify valves that relieve pressure;

(D) identify valves that regulate the direction of flow;

(E) identify types of valve actuators;

(F) explain how to properly store and handle valves;

(G) explain valve locations and positions;

(H) explain the factors that influence valve selection; and

(I) interpret valve markings and nameplate information.

(7) The student uses algebra to solve problems encountered in the plumbing and pipe fitting industry. The student is expected to:

(A) calculate area, volume, and circumference; and

(B) solve for right triangles using the Pythagorean Theorem.

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(1) The student develops a management plan for a project or an activity. The student is expected to:

(A) identify and describe the steps required to complete a project;

(B) determine and acquire the resources needed to complete a project; and

(C) develop a timeline to complete a project.

(2) The student applies the appropriate codes, laws, standards, or regulations related to a research and development project. The student is expected to:

(A) identify areas where codes, laws, standards, or regulations may be required;

(B) locate the appropriate codes, laws, standards, or regulations; and

(C) interpret and follow the appropriate codes, laws, standards, or regulations.

(3) The student describes the intended and unintended effects of construction management solutions. The student is expected to:

(A) use an assessment strategy to determine the risks and benefits of a research project; and

(B) describe how construction management has affected individuals, societies, cultures, economies, and environments.

(4) The student solves problems, thinks critically, and makes decisions related to research, design, and development. The student is expected to:

(A) develop or improve a product by following a problem-solving strategy;

(B) apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and

(C) apply decision-making techniques to the selection of technological solutions.

(5) The student describes the costs associated with research and development activities. The student is expected to:

(A) develop a budget for a research and development project; and

(B) determine the most effective way to minimize project costs.

(6) The student applies communication, mathematics, and science knowledge and skills to construction management activities. The student is expected to:

(A) write technical reports;

(B) deliver technical presentations to groups of individuals;

(C) identify and describe the mathematics concepts used in projects; and

(D) identify and describe the science concepts used in projects.

(7) The student predicts the marketability of a project, product, or service. The student is expected to:

(A) determine the customer's expectations concerning a project, product, or service;

(B) evaluate a project, product, or service to determine if it will meet the customer's expectations; and

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(C) deliver a project, product, or service and assess the customer's responses.

(8) The student uses advanced tools, materials, processes, and procedures in construction management. The student is expected to:

(A) determine and use the appropriate technology needed to solve a problem or complete a task;

(B) evaluate the use of technology in a given situation; and

(C) describe the factors that influence the use of technology in a variety of situations.

(9) The student designs a project using appropriate design processes and techniques. The student is expected to:

(A) use an accepted design process to design an object or a service;

(B) develop drawings, illustrations, or models; and

(C) establish design criteria and constraints.

(10) The student predicts the impacts of emerging and innovative applications of construction technology. The student is expected to:

(A) describe the emerging and innovative technologies being developed in a field; and

(B) identify the factors that may influence the adoption of emerging and innovative technologies.

(11) The student improves the quality of a product or service using different quality control techniques. The student is expected to:

(A) define quality;

(B) assess the quality of specific products and services; and

(C) determine how the quality of a product or service can be improved.

(12) The student recommends new ways to build products using different tools, equipment, machines, materials, and technical processes. The student is expected to:

(A) use a variety of tools, equipment, machines, materials, and processes to build products in a more efficient manner; and

(B) demonstrate advanced construction management skills.

(13) The student proposes safety devices required to complete different tasks. The student is expected to:

(A) recommend improvements to safety standards; and

(B) specify safety devices that allow for the safe completion of a task.

(14) The student performs advanced equipment maintenance. The student is expected to:

(A) handle and store tools and materials correctly;

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(B) locate and perform manufacturers' maintenance procedures on selected tools, equipment, and machines; and

(C) describe the results of negligent or improper maintenance.

(15) The student suggests how the cost of a project, product, or service can be reduced. The student is expected to:

(A) identify the factors that influence the cost of a project, product, or service; and

(B) select materials or processes that will reduce the cost of producing the product or delivering the service.

(16) The student applies knowledge and skills in mathematics, science, English language arts, and social studies as it relates to construction management. The student is expected to:

(A) develop a school-based learning activity in collaboration with the teacher and at least one related industrial mentor that provides an in-depth study of at least one aspect of construction management independent study;

(B) present the project in at least two formats such as model, graphic, verbal, written, or other to a panel of students, teachers, and practitioners in construction management; and

(C) deliver the project's final product(s) that demonstrate(s) the use of a variety of resources, technologies, and communications skills.

(17) The student exhibits employability skills that lead to job success in construction management. The student is expected to:

(A) demonstrate effective verbal, nonverbal, written, and electronic communication skills;

(B) demonstrate effective methods to secure, maintain, and terminate employment;

(C) demonstrate positive interpersonal skills, including conflict resolution, negotiation, teamwork, and leadership;

(D) evaluate the relationship of good physical and mental health to job success and achievement;

(E) demonstrate appropriate grooming and appearance for the workplace;

(F) demonstrate appropriate business and personal etiquette in the workplace; and

(G) exhibit productive work habits and attitudes.

(18) The student determines employment opportunities and preparation requirements for careers in the construction management industries. The student is expected to:

(A) determine preparation requirements for various levels of employment in a variety of careers in construction management;

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(B) analyze the future employment outlook of construction management;

(C) describe entrepreneurial opportunities in construction management;

(D) determine how interests, abilities, personal priorities, and family responsibilities affect career choice;

(E) compare rewards and demands for various levels of employment in a variety of careers; and

(F) determine continuing education opportunities that enhance career advancement and promote lifelong learning.

(19) The student demonstrates ethical and legal practices for careers in construction management. The student is expected to:

(A) summarize the rights and responsibilities of employers and employees;

(B) exhibit ethical practices as defined in construction management;

(C) analyze legal aspects of construction management;

(D) describe and use the scientific method, technological method, or universal systems model to conduct a research activity; and

(E) identify the inputs, processes, outputs, and feedback associated with research, design, and development activities.

(20) The student selects the appropriate technological resources to conduct research, design, and development activities. The student is expected to:

(A) apply technology to individual or community problems;

(B) describe the factors that affect the purchase and use of items;

(C) differentiate between research, design, and development; and

(D) distinguish between adaptation, imitation, innovation, and invention.

(21) The student designs or improves a product using appropriate design processes and techniques. The student is expected to:

(A) develop or improve a product or service that meets a specified need;

(B) identify areas where quality, reliability, and safety can be designed into a product;

(C) describe the functions and methodologies used in basic and applied research; and

(D) develop a project portfolio that documents a research and development project.