

**PLUMBING 3, 4**  
**(COURSE CODES: 6282, 6283)**

**COURSE DESCRIPTION:** Plumbers install, repair and maintain pipes, fixtures and other plumbing equipment used for water distribution and waste water disposal in residential, commercial and industrial buildings. They are employed in maintenance departments of factories, plants and similar establishments, by plumbing contractors, or they may be self-employed. Plumbers perform some or all of the following duties:

1. Read blueprints, drawings and specifications to determine layout of plumbing system, water supply network and waste and drainage systems
2. Install, repair and maintain domestic, commercial or industrial plumbing fixtures and systems
3. Locate and mark positions for pipe connections, passage holes and fixtures in walls and floors
4. Cut opening in walls and floors to accommodate pipe and pipe fittings
5. Measure, cut, bend and thread pipes using hand and power tools or machines
6. Join pipes using couplings, clamps, screws, bolts, cement or soldering, brazing and welding equipment
7. Test pipes for leaks using air and water pressure gauges
8. May prepare cost estimates.

If a student takes Introduction to Construction and scores 70% on all assessments (00101-15-00108-15), he or she does not have to repeat these modules in HVAC Technology, Building Construction, Cabinetmaking, Carpentry, Electricity, Masonry, Mechatronics, Plumbing, and Welding.

**OBJECTIVE:** Given the necessary equipment, materials, and instruction, the student, on completion of the prescribed course of study, will be able to successfully accomplish the following core competencies.

<b>RECOMMENDED GRADE LEVELS:</b>	9 - 12
<b>CREDIT:</b>	(120 hours) or 2 (240 hours) Carnegie units per course code
<b>PREREQUISITE:</b>	Plumbing 1, 2
<b>COMPUTER REQUIREMENT:</b>	One computer per student
<b>RESOURCES:</b>	SC Instructional Materials and Resources

**LEVEL 3, 4 (240 hours)**

**A. PLUMBING MATH 2**

**Proficient plumbing professionals demonstrate advanced math skills. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Calculate 11¼ -, 22½ -, 45-, 60-, and 72-degree offsets.
2. Check the squareness of a corner using the 3-4-5 ratio.
3. Lay out square corners using the 3-4-5 ratio.
4. Use a framing square to find the travel.
5. Use a folding rule to find given angles.
6. Calculate 11¼ -, 22½ -, 45-, 60-, and 72-degree offsets.
7. Calculate rolling offsets using constants for the angled fittings.
8. Calculate rolling offsets using a framing square.
9. Calculate 45-degree offsets around obstructions.

## **B. READING COMMERCIAL DRAWINGS**

**Proficient plumbing professionals demonstrate how to interpret commercial drawings and make decisions. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Interpret information from given site plans.
2. Verify dimensions shown on drawings and generate an RFI when you find discrepancies.
3. Locate plumbing entry points, walls, and chases.
4. Create an isometric drawing.
5. Do a material takeoff for drainage, waste, and vent (DWV) and water supply systems from information shown on drawings.
6. Use approved submittal data, floor plans, and architectural details to lay out fixture rough-ins, to develop estimates and establish general fixture locations.
7. Recognize the need for coordination and shop drawings.

## **C. HANGERS, SUPPORTS, STRUCTURAL PENETRATIONS, AND FIRE STOPPING**

**Proficient plumbing professionals demonstrate the appropriate use of hangers, supports, structural penetrations, and fire stopping materials. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the hangers and supports used to install DWV and water supply systems and explain their applications.
2. Install pipe hangers and supports correctly according to local applicable codes and manufacturer's specifications.
3. Modify structural members using the appropriate tools without weakening the structure.
4. Identify and install common types of fire-stopping materials used in penetrations through fire-rated structural members, walls, floors, and ceilings.

## **D. INSTALLING AND TESTING DWV PIPING**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of DWV piping. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Develop a material takeoff from a given set of plans.
2. Use plans and fixture rough-in sheets to determine location of fixtures and route of the plumbing.
3. Install a building sewer and a building drain.
4. Locate the stack within the structure.
5. Install a DWV system using appropriate hangers and correct grade or slope.
6. Modify structural members using the appropriate tools without weakening the structure.
7. Test a DWV system.

## **E. INSTALLING ROOF, FLOOR, AND AREA DRAINS**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of roof, floor, and area drains. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Use a surveyor's level or transit level to set the elevation of a floor or area drain.
2. Install a roof drain, a floor drain, and an area drain.
3. Install waterproof membranes and flashing.

## **F. INSTALLING AND TESTING WATER SUPPLY PIPING**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of water supply piping. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Develop a material takeoff from a given set of plans.
2. Use plans and fixture rough-in sheets to determine the location of fixtures and the route of the water supply piping.
3. Locate and size a water meter.
4. Locate a water heater, water softener, and hose bibbs.
5. Install a water distribution system using appropriate hangers.
6. Modify structural members, using the appropriate tools, without weakening the structure.
7. Correctly size and install a water service line, including backflow prevention.
8. Test a water supply system.

## **G. TYPES OF VALVES**

**Proficient plumbing professionals know the different types of valves and demonstrate how to service them. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the basic types of valves.
2. Describe the differences in pressure ratings for valves.
3. Demonstrate the ability to service various types of valves.

## **H. INSTALLING FIXTURES, VALVES, AND FAUCETS**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of fixtures, valves, and faucets. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the general procedures you should follow before installing any fixture.
2. Install bathtubs, shower stalls, valves, and faucets.
3. Install water closets and urinals.
4. Install lavatories, sinks, and pop-up drains.
5. Protect fixtures.

## **I. INSTALLING WATER HEATERS**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of water heaters. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the basic operation of water heaters.
2. Identify and explain the functions of the basic components of water heaters.
3. Install an electric water heater.
4. Install a gas water heater.
5. Describe the safety hazards associated with water heaters.

## **J. FUEL GAS SYSTEMS**

**Proficient plumbing professionals demonstrate the appropriate installation and testing of various gas fuel systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the major components of the following fuel systems and describe the
2. function of each component: natural gas, LP gas (liquefied petroleum gas), and fuel oil.
3. Identify the physical properties of each type of fuel.
4. Identify the safety precautions and potential hazards associated with each type of fuel and system.
5. Connect appliances to the fuel gas system properly.
6. Apply local codes to various fuel gas systems.
7. Design, size, purge, and test fuel gas systems.
8. Demonstrate familiarity with applicable fuel gas codes.

## **K. SERVICING OF FIXTURES, VALVES, AND FAUCETS**

**Proficient plumbing professionals demonstrate knowledge for servicing the fixtures, valves, and faucets. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify common repair and maintenance requirements for fixtures, valves, and faucets.
2. Identify the proper procedures for repairing and maintaining fixtures, valves, and faucets.

## **L. APPLIED MATH**

**Proficient plumbing professionals apply their math skills. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the weights and measures used in the English and metric systems.
2. Demonstrate an understanding of the concepts of area and volume.
3. Demonstrate an understanding of the practical applications of area and volume calculations.
4. Demonstrate an understanding of the concepts of temperature and pressure and how they apply to plumbing installations.
5. Explain the functions and applications of six simple machines.

## **M. CODES**

**Proficient plumbing professionals demonstrate knowledge of various model and local plumbing codes. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the model and local plumbing codes and their purposes.
2. Explain the procedure for modifying plumbing codes.
3. Demonstrate familiarity with the model code (if applicable) and local code used in your area.
4. Use the local plumbing code to find and cite references.

## **N. TYPES OF VENTING**

**Proficient plumbing professionals demonstrate knowledge and installation of different types of vents. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Demonstrate an understanding of the scientific principles of venting.
2. Design vent systems according to local code requirements.
3. Sketch the different types of vents.
4. Construct given vent configurations.
5. Install the different types of vents correctly.

## **O. INDIRECT AND SPECIAL WASTE**

**Proficient plumbing professionals demonstrate knowledge of indirect and special waste systems and how local code affects installation. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the reasons for using indirect systems.
2. Discuss the requirements for receptors and backflow preventers.
3. Demonstrate the ability to install an indirect waste system.
4. Identify the reasons for using special waste systems.
5. Describe the purpose of interceptors and how each type functions.
6. Sketch the basic installation and maintenance requirements for interceptors.
7. Describe the precautions that must be taken when installing interceptors to ensure ease of future maintenance and repair.
8. Install an interceptor.
9. Use the local plumbing code to cite the requirements for using indirect waste disposal systems.
10. Use the local plumbing code to cite the requirements for using special waste disposal systems.

## **P. SEWAGE PUMPS AND SUMP PUMPS**

**Proficient plumbing professionals demonstrate knowledge and appropriate installation methods of sewage pumps and sump pumps. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Explain the functions, components, and operation of sewage and sump pumps.
2. Size a storm water sump by calculating the runoff from paved and unpaved land surfaces.
3. Size a sewage sump by calculating the sewage flow from a structure.
4. Install and adjust sensors, switches, and alarms in sewage and sump pumps.
5. Troubleshoot and repair sewage and sump pumps.
6. Using a detailed drawing, identify system components.
7. Install a sump pump.

## **Q. BACKFLOW PREVENTERS**

**Proficient plumbing professionals demonstrate knowledge and appropriate installation methods of backflow preventers. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Explain the principle of backflow due to back siphonage or back pressure.
2. Explain the hazards of backflow and demonstrate the importance of backflow preventers.
3. Identify and explain the applications of the six basic backflow prevention devices.
4. Install common types of backflow preventers.

## **R. WATER PRESSURE BOOSTER AND RECIRCULATION SYSTEMS**

**Proficient plumbing professionals demonstrate knowledge and appropriate installation methods of water pressure booster and recirculation systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Explain the complete water pressure booster system and its components.
2. Explain the maintenance and basic troubleshooting processes for water pressure booster systems.
3. Describe the characteristics of the different recirculation systems.
4. Identify the basic components of a recirculation system.
5. Identify the location of various components within a recirculation system.
6. Install a water pressure booster system per engineering plans and specifications.
7. Install the basic components of a recirculation system.
8. Use the local plumbing code to find and cite requirements for recirculation systems.
9. Diagnose basic problems in recirculation systems.

## **S. SERVICING PIPING SYSTEMS, FIXTURES, AND APPLIANCES**

**Proficient plumbing professionals demonstrate knowledge and appropriate servicing methods for piping systems, fixtures, and appliances. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Diagnose water supply problems.
2. Diagnose water quality problems.
3. Explain different types of corrosion and their effects on pipes.
4. Diagnose and solve fixture and appliance problems.
5. Troubleshoot and repair water supply problems.
6. Troubleshoot and repair water heater problems.
7. Troubleshoot and repair water drainage problems.
8. Troubleshoot lawn irrigation systems.

## **T. ADVANCED BUSINESS MATH FOR PLUMBERS**

**Proficient plumbing professionals demonstrate the ability to estimate job costs for a plumbing job. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Correctly price a small job.
2. Understand how components of cost relate to profit.

## **U. SIZING DWV AND STORM SYSTEMS**

**Proficient plumbing professionals demonstrate knowledge for sizing DWV and storm systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Calculate drainage fixture units for waste systems.
2. Size building drains and sewers.
3. Size a vent system.
4. Identify and size special kinds of waste and vent systems.
5. Size roof drainage systems.

## **V. PRIVATE WATER SUPPLY SYSTEMS**

**Proficient plumbing professionals demonstrate knowledge and appropriate servicing methods for private water supply systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Identify the qualities of a good well.
2. Explain the operation of various types of pumps and well components.
3. Explain the installation of private water supply system components.
4. Troubleshoot a private water supply system.

## **W. ADVANCED UNIT X: PRIVATE WASTE DISPOSAL SYSTEMS**

**Proficient plumbing professionals demonstrate knowledge of private waste disposal systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the types of private waste disposal systems.
2. Discuss the maintenance and replacement of private waste disposal systems.
3. Discuss the local code requirements for private waste disposal systems.

## **X. LOCATING BURIED SEWER AND WATER LINES**

**Proficient plumbing professionals demonstrate knowledge of utility protection and notification procedures as well as the use of various equipment to locate buried sewer and water lines. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Use plans and blueprints to locate lines.
2. Use an electronic pipe locator to locate metallic and nonmetallic pipe.
3. Use a camera to locate and diagnose metallic and nonmetallic pipe.
4. Describe utility protection and notification procedures.

For schools with more classroom instructional hours, choose from the list of advanced standards for your second, third, and fourth year students.

## **Y. HYDRONIC AND SOLAR HEATING SYSTEMS**

**Proficient plumbing professionals demonstrate knowledge of hydronic and solar heating systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the basic types of hydronic and solar heating systems and their components.
2. Describe the procedures for roughing in and testing the piping in hydronic or solar heating systems.
3. Describe the procedures for installing equipment in hydronic or solar heating systems.
4. Describe the procedures used to test, balance, and start up hydronic or solar heating systems.

## **Z. WATER SUPPLY TREATMENT**

**Proficient plumbing professionals demonstrate knowledge of appropriate water supply treatment. The following accountability criteria are considered essential for students in the plumbing program of study.**

1. Flush out visible contaminants from plumbing systems.
2. Disinfect a potable water plumbing system.
3. Identify common water problems.
4. Practice methods used to soften water.
5. Analyze and measure water-conditioning problems.

## **AA. SWIMMING POOLS AND HOT TUBS**

**Proficient plumbing professionals demonstrate knowledge of swimming pools and hot tubs' systems and their installation. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Explain swimming pool and hot tub systems and their components.
2. Explain the local procedures and codes for plumbing a swimming pool.
3. Explain the local procedures and codes for plumbing a hot tub.
4. Discuss water quality issues related to swimming pools and hot tubs.
5. Identify and discuss backflow requirements for swimming pools and hot tubs according to local procedures and codes.

## **BB. COMPRESSED AIR**

**Proficient plumbing professionals demonstrate knowledge and appropriate installation of compressed air systems. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Discuss the installation of compressed air systems and their components and accessories.
2. Describe the applications of compressed air systems.
3. Identify the different methods of conditioning compressed air.
4. Identify the types, functions, and capacities of different air compressor systems.
5. Identify the safety issues related to compressed air systems.
6. Troubleshoot a compressed air system.

## **CC. PLUMBING FOR MOBILE HOMES AND MOBILE HOME PARKS**

**Proficient plumbing professionals demonstrate knowledge and appropriate installation for mobile homes and parks. The following accountability criteria are considered essential for students in the Plumbing program of study.**

1. Describe the proper location and layout of sewer and supply lines for a mobile home park.
2. Explain the procedure for connecting water and sewer lines to mobile homes.
3. Discuss code issues that are specific to mobile homes.
4. Explain a travel trailer park and its plumbing needs.
5. Describe a sanitary dump system.

***Safety, Student Organizations, Technology Knowledge, Personal Qualities and Employability Skills, and Professional Knowledge are to be embedded in Standards A-P.***

## **SAFETY**

**Professionals know the academic subject matter, including. They will use this knowledge. The following accountability criteria are considered essential for students in any program of study.**

1. Review school safety policies and procedures.
2. Review classroom safety rules and procedures.
3. Review safety procedures for using equipment in the classroom.
4. Identify major causes of work-related accidents in office environments.
5. Demonstrate safety skills in an office/work environment.

## **STUDENT ORGANIZATIONS**

**Professionals know the academic subject matter, including professional development. The following accountability criteria are considered essential for students in any program of study.**

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.
3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.
5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

## **TECHNOLOGY KNOWLEDGE**

**Professionals know the academic subject matter, including the ethical use of technology. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation.
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., piracy; illegal downloading; cyberbullying; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, Creative Commons, fair use laws, and ethics pertaining to downloading of images, photographs, Creative Commons, documents, video, sounds, music, trademarks, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.

## **PERSONAL QUALITIES AND EMPLOYABILITY SKILLS**

**Professionals know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving skills.
3. Demonstrate initiative and self-direction.
4. Demonstrate integrity.
5. Demonstrate work ethic.

6. Demonstrate conflict resolution skills.
7. Demonstrate listening and speaking skills.
8. Demonstrate respect for diversity.
9. Demonstrate customer service orientation.
10. Demonstrate teamwork.

## **PROFESSIONAL KNOWLEDGE**

**Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are considered essential for students in any program of study.**

1. Demonstrate global or “big picture” thinking.
2. Demonstrate career and life management skills and goal-making.
3. Demonstrate continuous learning and adaptability skills to changing job requirements.
4. Demonstrate time and resource management skills.
5. Demonstrates information literacy skills.
6. Demonstrates information security skills.
7. Demonstrates information technology skills.
8. Demonstrates knowledge and use of job-specific tools and technologies.
9. Demonstrate job-specific mathematics skills.
10. Demonstrates professionalism in the workplace.
11. Demonstrates reading and writing skills.
12. Demonstrates workplace safety.

Course Academic Alignment is found in the Instruction Hub.