Plumbing

45 Hours Training Program - TEVT Sector

Teaching - Learning Material

Project Implementation Unit

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Introduction

The 45-hour Plumbing Training is designed to equip the trainees with both theoretical and practical skills required to perform entry-level plumbing duties in both residential and commercial projects. Typically, this short, skill-based Training touches the basic aspects of plumbing, the choice and use of the proper tools, the fitting of pipe joints and fitting, the methods of installation, and other regular maintenance practices. To ensure the safety of others, the course also focuses on utilising the best practice and depth of expertise in plumbing, thus empowering the learners to support the daily maintenance roles, as well as to adhere to the normative procedures and to manage hygiene and regulations. Once they are completed, the trainees can be in a better place to assist the competent professional plumbers or become self-employed in the plumbing trade.

Training Objectives

Comprehend the fundamental principles of plumbing systems, including types of pipes, fittings, tools, and safety protocols used in residential and commercial environments.

Develop essential skills in pipe cutting, joining, fixture installation, leakage detection, and basic maintenance through hands-on practical training.

Design simple plumbing layouts for bathrooms and kitchens, incorporating water supply and drainage systems in compliance with standard codes and practices.

Training Learning Outcome (TLO)

TLO 1: The Trainee will be able to describe the standard installation sequence used in home plumbing systems as well as the purpose and classification of common plumbing tools, pipes, and fittings.

TLO 2: Following safety procedures and layout diagrams, the trainee will be able to use plumbing techniques to install, connect, and test water supply and drainage lines in a simulated setting.

Assessment Structure

Since this training is fast-track & skill-oriented, therefore special mode of assessment is recommended as under:

Component	Marks	Passing Criteria
Theory (MCQs + Short Questions)	30	50% (15 marks)
Practical (Capstone + Presentation)	70	60% (42 marks)
Total	100	To be eligible for the Certificate of Competency in Plumbing, trainees must maintain at least 75% attendance and successfully pass both the theory and practical components of the assessment.

Who Should Enrol?

- Minimum education level of middle or matriculation, particularly those interested in technical trades and vocational skills development.
- Unemployed individuals or informal sector workers looking to upskill or formalize their Practical plumbing knowledge for better job opportunities.
- Aspiring entrepreneurs or small business starters in the construction or home industry Maintenance sectors that wish to build competency in plumbing services.

- Helpers or assistants of plumbers, masons, or general construction workers aiming to advance their roles by acquiring specialized skills.

Training Module and Delivery Plan:

Total Training Hours	45 Hours
Training Methodology	**Theory**: 9 Hours (20%) **Practical**: 36 Hours (80%)
Medium of Instruction & Assessment	English & Urdu

Module 1: Health & Safety

1. Module Overview

This module develops foundational knowledge of occupational health, personal safety, hazard identification, and emergency preparedness in plumbing environments. Students will learn how to work safely with tools, chemicals, water systems, and mechanical equipment while preventing injuries and workplace accidents.

Learning Outcomes

By the end of this module, trainees will be able to:

✔ Describe the importance of workplace safety in plumbing
✔ Demonstrate correct personal protective measures
✔ Identify common hazards in plumbing worksites
✔ Respond appropriately during emergency situations
✔ Apply basic first aid for minor injuries

Lesson Unit LU1.1.1: Introduction to Safety

1.1 What is Safety?

Safety refers to preventing accidents, injury, damage, or health risks at the workplace.
Plumbing involves working with tools, heights, water pressure, gas lines, chemicals, and confined spaces — therefore **safety is required at all times**.

1.2 Why Safety is Important

- Protects workers from injuries and accidents
- Reduces equipment damage and project delays
- Improves workplace discipline and productivity
- Ensures compliance with safety laws and industry standards

1.3 Safety Responsibility

Responsibility	Description
Workers	Follow rules, wear PPE, report hazards
Supervisors	Provide instructions, monitor safety
Management	Provide equipment, training, emergency plans

Safety is everyone's duty — not only the supervisor.

1.4 Safety Rules for Plumbing Worksite

- Do not operate tools or machinery without training
- Keep floors and work areas clean
- Store tools properly after use
- Do not run or play inside work areas
- Report damaged tools immediately
- Follow written instructions and safety signs

Practical Activity

✔ Students will identify and list 10 safety rules observed on the training site.
✔ Trainer will demonstrate safe use of hand tools and ask students to repeat.

Lesson Unit LU1.1.2: Personal Safety Practices

2.1 Personal Protective Equipment (PPE) for Plumbers

PPE Item	Purpose
Safety Gloves	Protect hands from cuts and chemicals
Safety Goggles	Protect eyes from debris and flying particles
Hard Hat	Protection from falling objects
Safety Shoes	Prevent foot injuries & electric shocks
Mask/Respirator	Protect from dust, fumes, or welding smoke
Ear Plugs	Reduce loud noise exposure

2.2 Personal Hygiene

- Wash hands after using chemicals or touching waste pipes
- Keep nails trimmed and clean
- Avoid loose clothing that can catch in tools
- Do not eat or drink around chemicals or waste discharge points

2.3 Workspace Discipline

- Keep workplace organized
- Dispose waste in correct bins
- Clean tools after use
- Ensure proper lighting and ventilation

Lesson Unit LU1.1.3: Hazard Awareness

3.1 What is a Hazard?

A hazard is **anything that can cause harm, injury, disease, or damage.**

3.2 Common Plumbing Hazards

Hazard Type	Example	Possible Injury
Physical	Slipping on water, falling from ladder	Fractures, bruises
Mechanical	Sharp tools, broken equipment	Cuts, deep wounds
Electrical	Using power tools with wet hands	Electric shock, burns
Chemical	Pipe glue, solvents, cleaners	Skin burns, poisoning
Biological	Sewage, stagnant water	Infection, illness

3.3 Hazard Reporting

- Inform supervisor immediately
- Mark unsafe areas with tape/signs
- Stop work if danger is present
- Do not ignore or hide accidents

Lesson Unit LU1.1.4: Emergency Preparedness

4.1 What is an Emergency?

An unexpected event that threatens life, health, or property (fire, gas leak, electric shock, serious injury).

4.2 Emergency Actions

1. Stay calm
2. Stop working immediately
3. Inform supervisor or call emergency number

4. Move to a safe zone
5. Do not perform rescue alone if untrained

4.3 Emergency Exit Plans

- Know building exits and assembly points
- Do not use elevators during fire
- Follow safety officer instructions

4.4 Emergency Equipment

Equipment	Purpose
Fire Extinguisher	Control small fires
First Aid Kit	Treat minor injuries
Sand Buckets	Fire suppression & spill control
Emergency Alarms	Alert occupants

Practical Activity – Mock Drill

- Trainer conducts alarm drill
- Students evacuate to assembly area
- Time is recorded for training improvement

Lesson Unit LU1.1.5: Basic First Aid Awareness

5.1 What is First Aid?

Immediate temporary care given to an injured person before medical help arrives.

5.2 First Aid Box Contents

- Bandages, antiseptic, tape

- Scissors and gloves
- Burn cream
- Pain reliever
- Sterile cotton

5.3 Common Situations in Plumbing Work

Injury	Cause	Basic Response
Minor cuts	Sharp pipes, tools	Clean wound → apply bandage
Burns	Hot water, soldering torch	Cool burn under water → cover clean cloth
Eye irritation	Dust/chemicals	Wash with clean water → seek help if pain
Electric shock	Wet tools/outlets	Turn off electricity → call help

5.4 When to Seek Medical Help

- Deep wounds
- Continuous bleeding
- Unconsciousness
- Severe burns
- Broken bones

Module 1 – Assessment

A. Short Questions

1. Why is personal protective equipment important?
2. Define hazard and give three examples in plumbing.
3. What should you do if a fire occurs at the workplace?
4. List four contents of a first aid box.
5. Why must tools be stored properly?

B. True / False

	T/F
Safety is only the supervisor's responsibility.	
Plumbing involves physical, chemical and biological hazards.	
Electric shock can occur if tools are wet.	
PPE is optional for trained workers.	

C. Multiple Choice Questions

1. PPE stands for:
   a) Public Protection Equipment
   b) Personal Protective Equipment ✅
   c) Professional Plumbing Equipment
2. The best action during emergency is:
   a) Panic
   b) Run in different directions
   c) Stay calm and follow instructions ✅
3. Cuts and scraped injuries on hands can be prevented by:
   a) Using bare hands
   b) Wearing gloves ✅
   c) Wearing sandals

Module 2: Plumbing Basics & Tools

2. Module Overview

This module introduces the foundation of plumbing systems, types of pipes used in residential and commercial projects, basic mathematics, plumbing tools, safety procedures, and reading plumbing diagrams.

Students will learn to identify materials, measure and cut pipes, select fittings, and understand water supply vs. drainage layouts.

Learning Outcomes

By the end of this module, learners will be able to:

✔ Explain what plumbing systems are and where they are used
✔ Identify different types of pipes and fittings
✔ Use hand tools and power tools safely
✔ Measure and cut pipes correctly
✔ Read basic plumbing drawings and symbols
✔ Apply correct installation and safety procedures

LU 1.2.1 – Introduction to Plumbing Systems

2.1 What is Plumbing?

Plumbing is the system of pipes, fittings, valves, and fixtures used to supply clean water, remove wastewater, and support sanitation in homes and buildings.

2.2 Purpose of Plumbing

- Supply clean and safe drinking water
- Drain wastewater efficiently
- Maintain hygiene and sanitation
- Prevent leaks and contamination
- Support heating and irrigation systems

2.3 Residential vs. Commercial Plumbing

Feature	Residential (Homes)	Commercial (Offices, schools, hotels)
System Size	Smaller pipelines, low demand	Large pipelines, heavy water usage
Fixtures	Few bathrooms, small kitchens	Multiple bathrooms, restaurant kitchens
Pressure	Low to medium	Higher pressure requirement
Maintenance	Simple repairs	Specialized technicians required

2.4 Plumbing System Components

- Water supply lines
- Drainage and vent lines
- Fixtures (taps, toilets, showers)
- Water meters, pumps & valves
- Storage tanks & filtration units

LU 1.2.2 – Types of Pipes

Plumbers work with various pipes depending on usage, pressure, cost, and climate.

Common Pipe Types

Pipe Type	Full Form	Usage	Advantages	Disadvantages
PVC	Polyvinyl Chloride	Cold water supply, drainage	Lightweight, cheap	Not for hot water
CPVC	Chlorinated PVC	Hot & cold water supply	Heat resistant	Slightly expensive
PEX	Cross-linked Polyethylene	Residential supply lines	Flexible, no corrosion	UV sensitive
GI	Galvanized Iron	Old water systems, outdoor	Strong, durable	Heavy, rusts over tir
Copper	–	Hot water, heaters	Long life, bacteria resistant	Expensive
HDPE	High Density Polyethylene	Underground supply	Flexible, impact resistant	Special fittings required

Pipe Color Codes (General Industry Practice)

- Blue – cold water
- Red – hot water
- Black – drainage or sewer
- Yellow – gas lines (informational, optional module)

LU 1.2.3 – Pipe Sizing & Pressure Ratings

What is Pipe Size?

Diameter of pipe that determines how much water flows through it.

Common Sizes

- ½ inch
- ¾ inch
- 1 inch
- 2 inch (for main lines/drainage)

Pressure Rating

The maximum pressure a pipe can safely handle, shown as:

- PN6, PN10, PN16 (higher number = stronger)

Why Proper Sizing Matters

- Small pipe = low pressure
- Oversized pipe = material waste
- Wrong pipe = leakage, noise, damage

LU 1.2.4 – Essential Plumbing Tools

Plumbers use **hand tools** and **power tools**.

Hand Tools

Tool	Use
Pipe Wrench	Tightens or loosens threaded pipes
Adjustable Wrench	Fits many bolt sizes
Hacksaw	Cutting pipes
Pipe Cutter	Clean pipe cuts
Plier Set	Holding and tightening
Teflon Tape	Sealing pipe threads

Soldering and Brazing Tools

- Blow torch / gas torch
- Soldering wire
- Flux
- Heat-resistant gloves
  Used for copper and metal pipes.
-

Power Tools

Tool	Use
Electric Drill	Drilling holes for pipes
Angle Grinder	Cutting metal pipes
Heat Gun	Bending plastic pipes

Safety During Tool Usage

- Check tool condition before use
- Do not operate wet tools
- Wear gloves & goggles
- Keep fingers clear of cutting direction
- Unplug tool before adjusting blade

LU 1.2.5 – Safety Protocols

Personal Safety

- Wear PPE always
- Keep tools organized
- Lift pipes using correct posture
- Avoid loose clothing during cutting or drilling

Chemical Safety

Sealants, pipe glue, and solvent cement can be harmful.

Precautions:

- Use in well-ventilated area
- Wear gloves and mask
- Keep away from fire
- Read label instructions before use

LU 1.2.6 – Water Supply vs. Drainage Systems

Water Supply System

Brings clean water from source to fixtures

Component	Function
Main line	Supplies water to house
Valves	Control water flow
Pipes	Carry water under pressure
Storage tank	Holds water
Pump	Increases pressure

Characteristics:

- High pressure
- Clean water
- Small diameter pipes
- No smell

Drainage System

Removes dirty water from bathrooms, kitchens, toilets.

Component	Function
Waste pipes	Carry wastewater
P-trap	Prevents foul smells
Vent pipe	Allows air pressure balance
Sewer line	Carries waste to main drain

Characteristics:

- No pressure (uses gravity)
- Larger pipes (2–4 inches)
- Must maintain slope
- Includes traps and vents

LU 1.2.7 – Pipe Fittings & Connectors

Common Fittings

Fitting	Shape	Purpose
Elbow	↴	Changes direction
Tee	T-shape	Joins three pipes
Coupling	—	Joins two pipes
Union	○	Detachable joint
Reducer	>	Connects different pipe sizes
Valve		Controls flow
Trap	S / P	Stops foul gases

LU 1.2.8 – Basic Math for Plumbers

Plumbers calculate distances, slopes, pipe lengths, and rise/run.

Common Calculations

1. **Pipe Length = Wall Length − Fitting Allowance**
2. **Slope for Drain Pipe = 1 cm drop per 50 cm**

LU 1.2.9 – Reading Plumbing Diagrams

Symbols

Symbol	Meaning
○	Water outlet
⊣	Valve
▭	Tank
↓	Drain line
Δ	Vent

Module 2 – Assessments

Short Questions

1. What is the difference between residential and commercial plumbing?
2. Name three types of pipes used for hot water.
3. What is the purpose of a P-trap?
4. Why should tools be checked before use?
5. Explain slope in drainage.

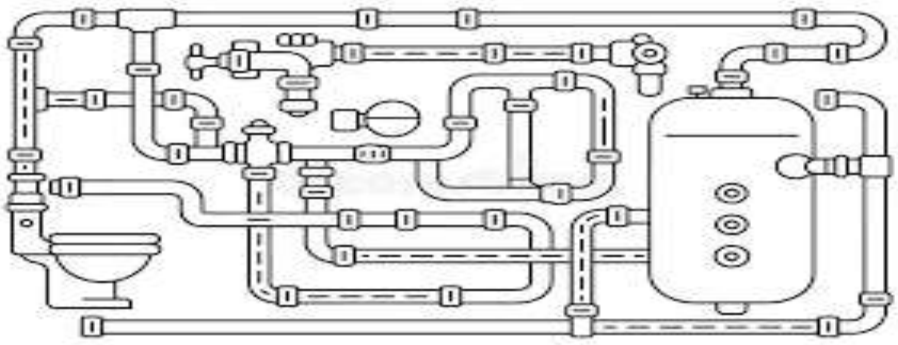
MCQs

1. PVC pipes are mainly used for:
   a) Hot water
   b) Cold water and drainage ✅
   c) Gas lines
2. PEX pipes are:
   a) Flexible ✅
   b) Made of metal
   c) Only used for drains

Practical Evaluation

✔ Measure and cut 1m PVC pipe
✔ Join using coupling and elbow
✔ Perform leak test
✔ Complete tool identification sheet

Module 3: Introduction to Plumbing Systems



3.1 What is Plumbing?

Plumbing is a network of pipes, fittings, valves, and fixtures that:

- Supplies clean drinking water
- Removes wastewater safely
- Maintains sanitation and hygiene in buildings

3.2 Purpose of Plumbing

- Provide clean water for drinking, cooking, washing, bathing
- Remove wastewater and sewage
- Prevent contamination and leaks
- Support heating, irrigation, and fire systems

✅ 3.3 Residential vs. Commercial Plumbing

Feature	Residential (Homes)	Commercial (Hotels, Schools, Offices)
System Size	Smaller pipelines	Large pipeline networks
Water Demand	Low to medium	Continuous heavy usage
Fixtures	Few bathrooms, simple kitchens	Many bathrooms, large kitchens
Pressure	Normal	High-pressure systems
Maintenance	Basic repairs	Specialized, frequent maintenance

✅ 3.4 Main Components of a Plumbing System

- Water supply pipes
- Drainage pipes
- Vent pipes
- Fixtures (taps, toilets, showers)
- Valves, pumps, meters
- Tanks and filters

✅ 3.5 Types of Pipes (LU 3.1)

Pipe	Full Form	Common Use	Advantages	Limitations
PVC	Polyvinyl Chloride	Cold water, drainage	Cheap, lightweight	Not for hot water
CPVC	Chlorinated PVC	Hot & cold water	Heat resistant	Costlier than PVC
PEX	Cross-linked Polyethylene	Internal water supply	Flexible, no rust	UV sensitive
GI	Galvanized Iron	Outdoor & old systems	Strong	Heavy, rusts
Copper	—	Hot water, heating	Long life, hygienic	Expensive
HDPE	High Density Polyethylene	Underground lines	Flexible, impact resistant	Special fittings needed

Pipe Colors (General Practice)

- Blue → Cold water
- Red → Hot water
- Black → Drainage
- Yellow → Gas lines (informational)

3.6 Pipe Sizing & Pressure (LU 3.2)

Pipe Sizes

- ½"
- ¾"
- 1"
- 2" or more for drains

Pressure Rating

- PN6, PN10, PN16
  (Higher rating = stronger pipe)

Why correct sizing matters

✔ Good water pressure
✔ Prevents leaks and noise
✔ Saves material cost

3.7 Essential Plumbing Tools (LU 3.3)

Hand Tools

Tool	Use
Pipe Wrench	Tightening threaded pipes
Adjustable Wrench	Bolts & nuts of various sizes
Hacksaw	Cutting pipes
Pipe Cutter	Smooth cuts on PVC/metal
Plier Set	Holding and tightening
Teflon Tape	Sealing threaded joints

Soldering Tools

- Gas torch
- Solder wire
- Flux
- Heat-resistant gloves
  (Used mainly for copper pipes)

Power Tools

Tool	Use
Electric Drill	Drilling holes
Angle Grinder	Cutting metal
Heat Gun	Bending plastic pipes

3.8 Safety While Using Tools (LU 3.4)

- Inspect tools before use
- Wear gloves and goggles
- Keep hands away from blades
- Do not use wet power tools
- Unplug before changing blade/bit
- Use chemical adhesives in ventilation

3.9 Water Supply vs. Drainage Systems (LU 3.5)

Water Supply System

- Brings clean, pressurized water to fixtures
- Small-diameter pipes
- No smell

Component	Function
Main Line	Feeds water from source
Valves	Control flow
Pump	Boosts pressure
Storage Tank	Stores water
Meters	Measure usage

Drainage System

- Removes wastewater using gravity
- Large pipes (2–4 inches)
- Must maintain slope
- Includes traps & vents

Component	Function
Waste Pipes	Carry used water

Component	Function
P-Trap	Stops foul smell
Vent Pipe	Balances air pressure
Sewer Line	Carries waste to main drain

3.10 Pipe Fittings & Connectors (LU 3.6)

Fitting	Purpose
Elbow	Changes pipe direction
Tee	Joins 3 pipes
Coupling	Joins 2 pipes
Union	Detachable joint
Reducer	Connects different sizes
Valve	Controls water flow
P-Trap	Prevents sewer smell

3.11 Basic Math for Plumbers (LU 3.7)

- **Slope for drain pipes:**
  ✅ *1 cm drop per 50 cm* (or 1/4" per foot)
- Measure pipe length accurately
- Subtract fitting allowance before cutting pipes

Module 3 – Assessments

Short Questions

1. Why is pipe sizing important?
2. Name 3 hand tools used in plumbing.
3. What does a P-trap do?
4. State one difference between water supply and drainage systems.
5. Which pipes are used for underground supply?

MCQs

1. PVC pipes are used for:
   a) Hot water
   b) Cold water & drainage ✅
   c) Gas supply
2. A Tee fitting connects:
   a) Two pipes

b) Three pipes ✅
c) Four pipes

3. Drainage systems work mainly on:
   a) Pressure
   b) Gravity ✅
   c) Electricity

Practical

✔ Measure and cut 1m PVC pipe
✔ Join pipes with coupling and elbow
✔ Perform leak test
✔ Identify 10 tools on a worksheet

Module 4: Water Supply System Installation

4.1 Introduction

A water supply system carries clean, pressurized water from the main source to different fixtures in a building (taps, toilets, showers, tanks, geysers).

A good installation must:

- Prevent leaks
- Maintain pressure
- Use correct pipe sizes and fittings
- Follow safety and hygiene standards

4.2 Sources of Water

Source	Description
Municipal Supply	Water provided by city/government authority
Borewell / Tube well	Water pumped from underground
Storage Tanks	Roof tanks, underground tanks
Filtration Units	Filters, RO units for drinking water

4.3 Main Components of Water Supply System

Component	Function
Main supply line	Brings water into the building
Stop/ Shutoff Valve	Turns water ON or OFF
Water Meter	Measures water consumption
Pressure Pump	Boosts pressure when supply is weak
Storage Tank	Stores water for later use
Distribution Lines	Carry water to individual fixtures
Valves	Control, isolate, or regulate flow

4.4 Types of Valves (LU 4.1)

Valve	Use
Gate Valve	Fully open or close water flow
Ball Valve	Quick ON/OFF control
Globe Valve	Controls flow rate/pressure
Check Valve	Prevents backflow
Float Valve	Controls tank filling

4.5 Pipe Routing – How Water Travels

1. Main line enters building
2. Shutoff valve installed near entry point
3. Water meter fitted for usage measurement
4. Line goes to:
    - **Overhead tank** OR
    - **Pressure pump**
5. From tank → distribution pipes → kitchen, bathroom, toilet, garden

4.6 Installation Steps (LU 4.2)

Step 1: Planning

- Measure pipe length
- Decide pipe size (½", ¾", 1")

- Mark wall and floor line

Step 2: Cutting and Joining Pipes

- Cut pipes using cutter/hacksaw
- Remove sharp edges
- Apply primer and solvent (for PVC/CPVC)
- Heat bending if needed
- Tighten threaded joints with Teflon tape

Step 3: Fixing Pipes

- Use clamps or brackets for support
- Maintain straight and level lines
- Avoid sharp bends to reduce pressure loss

Step 4: Connecting Fixtures

- Install taps, bib cocks, angle valves
- Connect geyser or heater if required

Step 5: Testing

- Open main valve
- Check for leaks
- Repair before sealing walls or flooring

4.7 Hot & Cold Water Lines (LU 4.3)

- **Blue** → Cold water
- **Red** → Hot water
- Hot water lines should use:
  - ✅ CPVC
  - ✅ PEX
  - ✅ Copper

Rules:

- Keep hot and cold lines separate
- Do not cross pipes
- Insulate hot water pipes to save energy

4.8 Pressure Problems & Solutions (LU 4.4)

Problem	Cause	Solution
Low pressure	Thin pipe, leaks, clogged aerator	Use larger pipe, fix leaks, clean aerator
No water in taps	Air lock	Open highest tap + lowest tap to release air
Water hammer	Sudden valve closing	Install air chamber or arrestor

4.9 Pipe Insulation & Freeze Protection (LU 4.5)

- Wrap insulation around exposed pipes
- Avoid running water pipes outside walls in cold areas
- Use sun-resistant insulation for rooftop lines

Purpose:
✔ Prevent pipe bursts
✔ Avoid heat loss
✔ Reduce condensation

4.10 Safety During Installation

- Shut off electricity near pump area
- Wear gloves and goggles
- Use ladder safely for rooftop work
- Do not overtighten plastic fittings
- Store adhesive and solvent away from fire

4.11 Practical Tasks

✔ Cut and join ½" PVC pipe
✔ Install a ball valve on pipeline
✔ Connect a tap and perform leak test
✔ Identify valves on a training board

Assessment – Module 4

Short Questions

1. Name three main components of a water supply system.
2. Why is a ball valve used?

3. What is the purpose of pipe insulation?
4. How do we test for pipe leaks?
5. Why is solvent cement used?

MCQs

1. Which valve shuts water ON/OFF quickly?
   a) Gate valve
   ✅ b) Ball valve
   c) Float valve
2. A water meter is used for:
   a) Filtering water
   ✅ b) Measuring water usage
   c) Stopping backflow
3. CPVC pipes are used for:
   a) Drainage
   ✅ b) Hot & cold supply
   c) Gas lines

Module 5: Drainage & Wastewater Systems

5.1 Introduction

A drainage system removes used water from bathrooms, kitchens, toilets, and carries it safely to the main sewer line or septic tank.
A good drainage system prevents:

- Bad smells
- Blockages
- Leakage
- Health hazards
- Flooding and water damage

5.2 Characteristics of Drainage System

Feature	Explanation
Gravity based	Water flows downward without pressure
Larger pipes	2–4 inch diameter

Feature	Explanation
Uses slope	Minimum 1 cm fall per 50 cm
Must stay clean	No sharp bends, no leakages
Includes traps and vents	Prevent odor and maintain air flow

5.3 Components of Drainage System

Component	Use
Waste Pipes	Carry dirty water
Soil Pipes	Carry toilet waste
P-Trap / S-Trap	Stops sewer gases from entering bathroom
Vent Pipe	Allows air to escape, prevents vacuum
Clean-out Point	Opening to remove blockages
Inspection Chamber	Manhole for maintenance

5.4 Types of Drainage Pipes

Pipe Type	Usage	Advantage
PVC	House drainage	Smooth flow, no rust
Cast Iron	Old buildings, heavy duty	Strong, soundproof
HDPE	Underground sewage	Flexible, durable
Clay Pipes	Very old systems	Good chemical resistance

5.5 What is a Trap? (LU 5.1)

A trap holds water and blocks foul gases.

Trap	Location	Shape
P-Trap	Sinks, wash basins	“P” shape
S-Trap	Toilets	“S” shape
Bottle Trap	Under basin where space is small	Bottle shape

If trap is dry → bad smell enters room
→ Always maintain water seal.

5.6 Venting System (LU 5.2)

Vent pipe allows fresh air into drainage system.

Helps:

- Prevent foul smell
- Keep water seal in traps
- Improve drainage speed

Rules:

- Should be vertical
- Should end above roof level
- Should not connect inside living spaces

5.7 Slope Requirement (Very Important)

Drainage depends on gravity.

✅ Standard slope = **1 cm drop every 50 cm**
✅ Too much slope = water flows but solids stay, causing blockage
✅ No slope = water stands and pipe blocks

5.8 Common Fittings in Drainage

Fitting	Use
Elbow (long sweep)	Smooth direction change
Tee / Wye	Connect branch pipes to main
Coupling	Join two pipes
Cleanout fitting	Remove blockages
Floor Trap	Collect floor water & block smell

5.9 Septic System Basics (If no city sewer)

A septic system contains:

1. **Septic Tank** – Waste separates into solids and liquids
2. **Soak Pit / Drain Field** – Water filters into soil
3. **Vent Pipe** – Releases gases

Maintenance:
✔ Clean after 2–3 years
✔ Do not throw plastic, diapers, cloth in toilet

5.10 Installation Procedure (LU 5.3)

Step 1: Planning

- Follow building layout
- Mark slope direction
- Decide pipe diameter

Step 2: Cutting and Joining

- Use hacksaw/cutter
- Deburr edges
- Apply solvent cement (PVC)

Step 3: Fixing Pipes

- Use pipe clips and clamps
- Maintain slope
- Avoid sharp turns

Step 4: Install Traps & Vents

- Fit P-trap under basin
- Connect vent pipe vertically

Step 5: Testing

- Fill water and check flow
- Observe for leaks
- Test toilet flush speed

5.11 Common Problems & Solutions (LU 5.4)

Problem	Cause	Fix
Bad smell inside bathroom	Dry trap	Pour water into trap
Slow drainage	Blockage, wrong slope	Use rod, chemical, correct slope
Toilet backflow	Choked main pipe	Clear sewer line

Problem	Cause	Fix
Noise in pipes	No vent pipe	Install vent
Leaks at joints	Poor glueing	Rejoin with solvent

5.12 Safety in Drainage Work

✔ Wear gloves, mask, goggles
✔ Avoid inhaling sewer gases
✔ Use ladder carefully in manholes
✔ Do not smoke near sewage
✔ Wash hands after work

5.13 Practical Tasks

✔ Cut and join 2" PVC pipe
✔ Install P-trap below wash basin
✔ Set drainage pipe with correct slope
✔ Clear blockage using rod or snake tool

Assessment – Module 5

Short Questions

1. Why do drainage pipes need slope?
2. What is the purpose of a P-trap?
3. Name two common drainage problems.
4. What is the function of a vent pipe?
5. Why is PVC used for drainage?

MCQs

1. Drainage depends mainly on:
   a) Pressure
   ✅ b) Gravity
   c) Pump
2. A P-Trap prevents:
   a) Water supply
   ✅ b) Bad smell from sewer
   c) Pipe insulation
3. Slow drainage occurs due to:
   a) Good slope
   ✅ b) Blockage
   c) Clean pipes

Module 6: Environmental Issues in Plumbing

6.1 Introduction

Plumbing plays an important role in protecting the environment.
Good plumbing helps:

- Save water
- Reduce pollution
- Keep homes and community clean
- Promote health and hygiene

Poor plumbing causes:

- Water waste
- Contamination
- Drain blockages and flooding
- Damage to soil and groundwater

6.2 Types of Environmental Hazards

Environmental hazards in plumbing occur when systems are not installed or maintained properly.

Hazard	Example	Result
Water Leakage	Dripping taps, pipe joints leaking	Wastage of clean water
Sewage Overflow	Blocked drains	Bad smell, diseases
Chemical Pollution	Wrong disposal of cleaners, paints, oils	Soil & water contamination
Waste Material	Cement, plastic, pipe pieces	Clogging of drains
Cross-Contamination	Supply water mixing with drainage	Unsafe drinking water

6.3 Impact of Human Activity on Environment

Plumbers and users both affect the environment.

Actions that Harm the Environment

- Leaving taps open
- Using old leaking pipes
- Throwing wipes, oil, or plastics in toilets/sinks
- Burning plastic pipes

- Incorrect disposal of chemical sealants

Negative Effects

- Water shortage
- Soil contamination
- Spread of bacteria and viruses
- Pollution of rivers and groundwater

6.4 Conservation & Sustainability

Sustainability means using resources wisely so they last for future generations.

Ways Plumbers Help the Environment

1. Repair leaks quickly
2. Install water-saving fixtures
3. Use eco-friendly materials
4. Avoid overuse of chemicals
5. Proper disposal of waste material
6. Promote rainwater harvesting
7. Reduce pipe damage by careful installation

6.5 Climate Change & Its Effect on Water Systems

Climate change leads to:

- Less rainfall
- Groundwater shortage
- Higher water heating costs
- Flooding and drain overload

Plumbing solutions:

- Low-flow taps and showers
- Insulated hot water pipes
- Efficient drainage slope
- Rainwater storage tanks

6.6 How to Contribute to Environmental Protection

Action	Benefit
Fix leakages immediately	Saves water
Install dual-flush toilets	Uses less water per flush
Use PEX, HDPE, PVC pipes responsibly	Less corrosion, long life

Action	Benefit
Do not burn PVC or plastic waste	Prevents toxic fumes
Clean grease traps regularly	Prevents drain blockages
Cover drains and manholes	Stops garbage entry

Practical Activities

✔ Inspect home/building for leaks
✔ Check water meter reading before & after fixes
✔ Install aerator on faucet and compare water usage
✔ Create a drainage trap cleaning demonstration
✔ Separate plumbing waste into recyclable and non-recyclable

Module 6 – Assessment

Short Questions

1. List two environmental hazards caused by poor plumbing.
2. How does leakage affect the environment?
3. What is meant by sustainability?
4. Name two ways plumbers reduce water wastage.
5. What happens if chemicals enter the drainage system?

MCQs

1. Which action saves water?
   a) Burning plastic pipes
   ✅ b) Repairing leaks
   c) Throwing waste in drain
2. Clogged drains cause:
   a) Clean water
   ✅ b) Sewage overflow
   c) Faster flow
3. Dual flush toilets:
   a) Waste more water
   ✅ b) Save water
   c) Have no effect

How Plumbers Can Contribute to Environmental Protection

Plumbers play an important role in protecting the environment. The way plumbing systems are installed, repaired, and maintained can save water, reduce pollution, and protect natural resources. Below are simple ways plumbers and plumbing businesses can help the environment.

1. Save Water

Water is a valuable resource. Plumbers can help save water by:

- Installing **water-saving taps, showers, and toilets**
- Fixing leaks immediately
- Checking water tanks and pipelines for wastage
- Educating customers on how to reduce water usage

2. Use Energy-Efficient Equipment

Plumbing systems often use pumps, heaters, or motors.
To save energy:

- Use **energy-efficient water heaters**
- Install **solar water heating systems**
- Recommend energy-efficient pumping systems
- Turn off equipment when not in use

3. Reduce Pipe and Material Wastage

- Measure and cut pipes carefully
- Reuse leftover materials whenever possible
- Return extra materials to store instead of throwing away
- Avoid burning plastic waste

4. Proper Waste Disposal

Plumbing waste includes damaged pipes, old fittings, and packaging.
To protect the environment:

- Dispose of waste only in proper bins
- Separate metal, plastic, and recyclable items
- Never throw chemicals or paint into drains
- Avoid releasing dirty water into open streets or fields

5. Control Water Pollution

Plumbers can prevent contamination of water systems by:

- Installing proper drainage systems

- Ensuring sewage lines do not mix with drinking water lines
- Checking for backflow and using backflow prevention devices
- Maintaining manholes, traps, and septic systems properly

6. Encourage Eco-Friendly Materials

- Prefer **PVC-U, PPR, CPVC** or other eco-friendly pipes
- Use **lead-free materials**
- Recommend low-flow fixtures and smart water-saving systems

7. Support Rainwater Harvesting

Plumbers can install systems that store rainwater for:

- Gardening
- Washing
- Toilets
- Cleaning

This reduces pressure on the water supply system.

8. Prevent Soil and Land Pollution

- Do not dump construction waste in open areas
- Store cement, sand, and chemicals safely
- Prevent oil and chemical spills during work

9. Educate Customers

Plumbers can guide customers to:

- Repair leaks early
- Use water-saving fixtures
- Avoid throwing oil, grease, or chemicals into drains

Even small advice can save thousands of litres of water.

10. Follow Government Laws and Safety Rules

- Follow environmental safety regulations
- Use approved plumbing materials
- Report illegal connections or sewage dumping

Module 7: Plumbing Drawings & Symbols

Module Objectives

By the end of this module, learners will be able to:

1. Read and interpret standard plumbing drawings.
2. Identify common plumbing symbols used in construction blueprints.
3. Understand the layout of water supply and drainage systems.
4. Create simple layout sketches for plumbing installations.

1 Introduction to Plumbing Drawings

Plumbing drawings are technical diagrams that show the design and installation of water supply, drainage, sanitary lines, fixtures, valves, pumps, and fittings inside a building.

They help plumbers:
✔ Understand where to install pipes, fittings, and fixtures
✔ Avoid cutting structural parts (beams, columns, slabs)
✔ Estimate material and labour cost
✔ Coordinate with electricians, masons, and HVAC technicians

Types of drawings:

- **Water Supply Layouts**
- **Drainage & Sewage Layouts**
- **Isometric Plumbing Diagrams**
- **Shop Drawings (detailed installation drawings)**
- **As-built drawings** (made after installation)

7.2 Common Plumbing Symbols

Plumbing symbols are standard shapes used to represent fixtures and components on drawings. Some commonly used symbols:

Component	Symbol Meaning
WC / Toilet	Shows water closet location
Basin / Sink	Hand wash or kitchen sink

Component	Symbol Meaning
Shower / Bathtub	Bathroom water outlet
Valve (Gate/Ball/Check)	Shows where flow can be controlled
Pump	Water circulation or boosting
Water Tank	Overhead, underground, or storage tank
Pipe Sizes	Diameter written along pipe line

7.3 Pipe Layout Representation

On drawings, pipes are represented by lines:

- **Blue Line** → Cold Water
- **Red Line** → Hot Water
- **Thick Line** → Main supply pipe
- **Thin Line** → Branch pipe

Directional arrows show the flow of water.

7.4 Isometric Plumbing Drawings

Isometric drawings show pipes in **3D view** (vertical + horizontal directions).
Advantages:

- Helps understand elevations and pipe routing
- Used to avoid clashes with beams or other services
- Clear visualization of how the system will be installed

Students will learn how to:
✔ Identify pipe routing on 3D diagrams
✔ Determine pipe length and materials
✔ Find connections between floors

7.5 Sanitary & Drainage Drawings

These drawings include:

- Soil and waste pipes
- Vent pipes
- Manholes
- Traps (P-trap, S-trap, floor trap)
- Slope/gradient of drainage lines

Proper slope is critical:

- Too steep → water runs fast, solids remain, pipe chokes
- Too flat → flow becomes slow, foul smell and blockage

7.6 Reading a Complete Drawing

Students must be able to identify:
✔ Location of water tank
✔ Route of main supply line
✔ Fixture positions (WC, basin, shower, etc.)
✔ Drainage outlets and manholes
✔ Pipe diameters
✔ Floor-wise plumbing system

7.7 Mini Project (Class Activity)

Students will:

1. Study a sample bathroom plumbing drawing.
2. Mark water pipe & drainage lines.
3. Identify fixtures and pipe diameter.
4. Prepare a simple isometric drawing for a small washroom.

Trainer Notes

- Use real house or building drawings for demonstration.
- Teach symbols step-by-step to avoid confusion.
- Conduct drawing interpretation tests.

Assessment Criteria

Learner is considered competent if they can:
✅ Correctly identify plumbing symbols
✅ Read water supply & drainage layout on a drawing
✅ Explain pipe direction, size, and fixture locations
✅ Make a basic plumbing sketch using standard symbols

KP-RETP Component 2: Classroom SECAP Evaluation Checklist

Purpose:

To ensure that classroom-based skills and entrepreneurship trainings under KP-RETP are conducted in an environmentally safe, socially inclusive, and climate-resilient manner, in line with the Social, Environmental, and Climate Assessment Procedures (SECAP).

Evaluator:_____

Training Centre / Location:_____

Trainer:_____

Date: _____

Category	Evaluation Points	Status		Remarks /Recommendation
		Yes	NO	
Social Safeguards	Is the training inclusive (equal access for women, youth, and vulnerable groups)?			
	Does the classroom environment ensure safety and dignity for all participants (no harassment, discrimination, or child Labor)?			

	Are Gender considerations integrated into examples, discussions, and materials?			
	Is the Grievance Redress Mechanism (GRM) process, along with the relevant contact number, clearly displayed in the classroom			
	Are the Facilities and activities being accessible and inclusive for specially-abled (persons with disabilities)			

Environmental Safeguards	Is the classroom clean, ventilated, and free from pollution or hazardous materials?			
	Is there proper waste management (bins, no littering)			
	Are materials used in practical sessions environmentally safe (non-toxic paints, safe disposal of wastes)?			
	Are lights, fans, and equipment turned off when not in use			

	(energy conservation)?			
Climate Resilience	Are trainees oriented on how their skills link with climate-friendly practices (e.g., renewable energy, efficient production, recycling)?			
	Are trainers integrating climate-smart examples in teaching content?			
	Are basic health and safety measures available (first aid kit, safe exits, fire safety)?			

	Is the trainer using protective gear or demonstrating safe tool use (where relevant)?			
Institutional Aspects	Is SECAP awareness shared with trainees (via short briefing, posters, or examples)?			
	Are trainees encouraged to report unsafe, unfair, or environmentally harmful practices?			
Overall Compliance	Overall SECAP compliance observed	☐ High ☐ Medium ☐ Low		

Overall remarks/ recommendations			
Name	**Designation**	**Signature**	**Date**