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# National Vocational and Technical Training Commission (NAVTTTC)

## Curriculum for Plumber

cum solar water heating technician

**(NVQF level 3)**

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## **1. Introduction**

The construction industry, one of the leading industries in Pakistan, the Middle East and other parts of the world, offer a range of prosperous occupational areas, such as plumbing. Plumbers play a vital role in installing, repairing and maintaining pipes, fixtures and other plumbing used for water distribution and wastewater disposal in residential, commercial and industrial buildings. The increased use of solar energy has further added to the demand of Plumbers having the skills to install and maintain solar-thermal water heating systems. Thus, the ever-growing demand of industry has led to the design of this training programme as a response to providing appropriate skills.

### **1.1 Overall course objective**

The aim of this programme is to produce employable Plumbers who are competent to install, remove, check, repair, replace or service different types of bathrooms and kitchen fixtures, including solar water heating installations. In addition, this programme aims to prepare unemployed youth to find employment in the construction industries or to enable them in becoming successful as entrepreneur.

### **1.2 Course competencies**

After completion of training the trainees will be able to:

- Maintain Safety;
- Interpret Drawing;
- Maintain Tools & Equipment;
- Perform laying out and excavation;
- Join pipes;
- Install water, gas and solar fittings;
- Install sewerage fittings;
- Install sanitary wares and CP fitting;
- Install solar water heating systems;
- Follow safe work procedures;
- Perform preventive and corrective maintenance;
- Perform Quality Checks; and,
- Maintain Documentation.

### **1.3 Job opportunities**

The pass out of this course would be able to:

- Plumber with construction companies
- Plumber in government departments, factories, plazas, residential colonies and in other building complex
- Salesman at sanitary/pipe stores or sales agents of different manufacturers of plumbing materials
- Self Employment

### **1.4 Trainee entry level**

Individuals who wish to enter this course of study have to comply against the following criteria:

- Grade 8 (Middle) or equivalent;
- Comfort level of English language and mathematics;
- Qualified Plumber – NVQF level 2, or equivalent.

### **1.5 Minimum qualification of trainer**

Trainers who wish to offer this programme should meet one of the following requirements:

- B.Sc. Eng and 2 years of relevant work experience; or
- B-Tech and 4 years of relevant work experience; or
- DAE Civil/Mechanical and 5 years of relevant work experience; or
- Certificate as Plumber with 8 years relevant work experience

Trainers offering this programme must be computer literate and be conversant with the delivery of competency-based education and training (CBET). All legislative requirements applicable to carry out training and assessment, if any, must be complied with.

## 1.6 Teaching strategies in a competency-based environment

Training in a competency-based environment differs from the traditional method of training delivery. It is based on defined competency standards, which are industry oriented.

The traditional role of a trainer changes and shifts towards the facilitation of training. A facilitator in CBET encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using specialist equipment, working on computers doing research on the Internet or the library. As trainees learn at different pace they might well be at different stages in their learning, thus learning must be tailored to suit individual needs.

The following facilitation methods (teaching strategies) are generally employed in CBET programmes:

- **Direct Instruction Method:** This might be effective when introducing a new topic to a larger group of trainees in a relative short amount of time. In most cases this method relies on one-way communication, hence there are limited opportunities to get feedback on the trainee's understanding.
- **Discussion Method:** This allows trainees to actively participate in sharing knowledge and ideas. It will help the trainer to determine whether trainees understand the content of the topic. On the other hand, there is a possibility of straying off topic under discussion and some trainees dominating others on their views.
- **Small Group Method:** Pairing trainees to help and learn from each other often results in faster knowledge/skill transfer than with the whole class. The physical arrangement of the classroom/workshop and individual assessment may be challenging.
- **Problem Solving Method:** This is a very popular teaching strategy for CBET. Trainees are challenged and are usually highly motivated when they gain new knowledge and skills by solving problems (Contingency skills). Trainees develop critical thinking skills and the ability to adapt to new learning situations (Transfer skills). It might be time consuming and because trainees sometimes work individually, they may not learn all the things that they are expected to learn.
- **Research Method:** This is used for workshops and laboratory tasks, field experiments, and case studies. It encourages trainees to investigate and find answers for themselves and to critically evaluate information. It however requires a lot of time and careful planning of research projects for the trainee.

## 1.7 Medium of instructions

- Urdu, local languages and/or English

## 1.8 Sequence and delivery of the modules

The curriculum for Plumber – NVQF level 3, consists of three (3) modules. The delivery of the modules (sequence) is suggested as follows:

**Module 1:** Installation

**Module 2:** Solar water heating -Installation

**Module 3:** Entrepreneurship

Learning units within these modules can be delivered interchangeably as stand-alone modules or in an integrated approach.

## 1.9 Duration of the course

The proposed curriculum is composed of 3 modules, which will be delivered over 1440 hours i.e. one (1) year(5 days/week & 6 Hours/day).

The distribution of training hours is as follows:

a) Total Training hours	=	1440 Hours
b) Theory	=	288 Hours (20%)
c) Practical	=	1152 Hours (80%)

2. Overview about the programme – Curriculum for Plumber – NVQF Level 3:

Module Title	Learning Units	Theory <sup>1</sup> Days/hours	Workplace <sup>2</sup> Days/hours	Timeframe of modules
<b>Module 1:</b> Installation	<b>LU-1:</b> Plan and calculate cost <b>LU-2:</b> Install appliances	<b>56</b>	<b>224</b>	<b>280</b>
<b>Module 2:</b> Solar water heating - Installation	<b>LU-1:</b> Plan and prepare for installing solar water heating system <b>LU-2:</b> Install and commission solar water heating system	<b>200</b>	<b>800</b>	<b>1000</b>
<b>Module 3:</b> Entrepreneurship	<b>LU-1:</b> Plan for own business <b>LU-2:</b> Implement financial strategy <b>LU-3:</b> Develop marketing strategies	<b>32</b>	<b>128</b>	<b>160</b>

<sup>1</sup>Learning hours in training provider premises

<sup>2</sup>Training workshop, laboratory and on-the-job workplace

### 3. Plumber– Curriculum Contents

<b>Module 1:</b>	<b>Installation</b>					
<b>Objective of the Module:</b>	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> <li>• Plan and calculate cost</li> <li>• Install appliances</li> </ul>					
<b>Duration:</b>	<b>Total:</b>	<b>280 hours</b>	<b>Theory:</b>	<b>56 hours</b>	<b>Practice:</b>	<b>224 hours</b>
<b>Learning Unit</b>	<b>Learning Outcomes</b>	<b>Learning Elements</b>	<b>Duration (Hours)</b>	<b>Materials Required</b>	<b>Learning Place</b>	
<b>LU-1: Plan and calculate cost</b>	1.1 Identify and obtain safety and other regulatory requirements as per job requirement	<ul style="list-style-type: none"> <li>• Safety requirements; Specifications; Hazard identification</li> </ul>	<b>Total</b> 140 Hrs		<b>Theory</b> Classroom	
	1.2 Interpret and confirm layout plan	<ul style="list-style-type: none"> <li>• Distribution points</li> <li>• Location for installation</li> </ul>	<b>Theory</b> 28 Hrs			
	1.3 Produce basic technical drawing and sketch	<ul style="list-style-type: none"> <li>• Drawings and symbols specifications</li> <li>• Dimensioning</li> <li>• Scaling</li> </ul>	<b>Practical</b> 112 Hrs			
	1.4 Perform measurements	<ul style="list-style-type: none"> <li>• Measuring units and conversions</li> <li>• Marking out and measure pipes</li> </ul>				
	1.5 Produce estimate of overall cost	<ul style="list-style-type: none"> <li>• Labour cost</li> <li>• Material cost</li> </ul>				
					<b>Practical</b> Lab Workshop	



<b>LU-2: Install appliances</b>	1.1 Identify safety hazards	<ul style="list-style-type: none"> <li>• Risk and hazards identification</li> </ul>	<b>Total</b> 140 Hrs		<b>Theory</b> Classroom
	1.2 Demonstrate procedures for joining pipes and fittings	<ul style="list-style-type: none"> <li>• Joining techniques</li> <li>• Pipe and pipe fittings</li> <li>• Modifications as required</li> <li>• Safety precautions</li> </ul>	<b>Theory</b> 28 Hrs		<b>Practical</b> Lab
	1.3 Demonstrate procedures for installing sanitary ware	<ul style="list-style-type: none"> <li>• Methods of leveling</li> <li>• Marking out <ul style="list-style-type: none"> <li>- Installation points</li> <li>- Fixtures</li> </ul> </li> </ul>	<b>Practical</b> 112 Hrs		Workshop Local industry
	1.4 Conduct operational testing	<ul style="list-style-type: none"> <li>• Product knowledge</li> </ul>			
	1.5 Perform final quality inspection	<ul style="list-style-type: none"> <li>• Importance of quality;</li> <li>• Handing over to client</li> <li>• Completing work related documents</li> </ul>			
	1.6 Clean up and store tools, equipment and materials	<ul style="list-style-type: none"> <li>• Waste disposal procedures;</li> <li>• Care of tools and equipment</li> </ul>			

<b>Module 2:</b>	<b>Solar water heating- Installation</b>				
<b>Objective of the Module:</b>	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> <li>• Plan and prepare for installing solar water heating system</li> <li>• Install and commission solar water heating system</li> </ul>				
<b>Duration:</b>	<b>Total:</b> <b>1000 hours</b>	<b>Theory:</b> <b>200 hours</b>	<b>Practice:</b> <b>800 hours</b>		
<b>Learning Unit</b>	<b>Learning Outcomes</b>	<b>Learning Elements</b>	<b>Duration (Hours)</b>	<b>Materials Required</b>	<b>Learning Place</b>
<b>LU-1: Plan and prepare for installing solar water heating system</b>	1.1 Distinguish between domestic and commercial use	<ul style="list-style-type: none"> <li>• Domestic or commercial use:               <ul style="list-style-type: none"> <li>- Purpose</li> <li>- Size</li> <li>- Location</li> <li>- Usage</li> <li>- Demand</li> </ul> </li> </ul>	<b>Total</b> 500 Hrs <b>Theory</b> 100 Hrs <b>Practical</b> 400Hrs		<b>Theory</b> Classroom  <b>Practical</b> Lab Workshop
	1.2 Analyse the water discharge level	<ul style="list-style-type: none"> <li>• Water levelling</li> <li>• Outflow / Inflow of water</li> <li>• Types of valves</li> <li>• Measurements</li> </ul>			
	1.3 Determine the demand of water during day	<ul style="list-style-type: none"> <li>• Height</li> <li>• Tank level</li> <li>• Tank capacity</li> <li>• Solar panel capacity</li> <li>• Pipe discharge level</li> <li>• Future demand</li> </ul>			

	1.4 Describe factors affecting the performance of solar heater	<ul style="list-style-type: none"> <li>• Radiation level</li> <li>• Temperature</li> <li>• Angle of inclination</li> </ul>			
	1.5 Conduct site assessment	<ul style="list-style-type: none"> <li>• Determine location for installation</li> <li>• Measurements</li> <li>• Physical structure</li> <li>• Light radiation</li> <li>• Safety hazards</li> </ul>			
	1.6 Draw layout for solar water heating system	<ul style="list-style-type: none"> <li>• Drawing specifications</li> <li>• Pipe and fitting specifications <ul style="list-style-type: none"> <li>- Quality</li> <li>- Quantity</li> </ul> </li> <li>• Other requirements <ul style="list-style-type: none"> <li>- Tools</li> <li>- Material</li> <li>- Consumables</li> </ul> </li> </ul>			
<b>LU-2: Install and commissionsolar water heating system</b>	2.1 Obtain and interpret installation requirements	<ul style="list-style-type: none"> <li>• Installation requirements</li> <li>• Hazard identification</li> </ul>	<b>Total</b> 500 Hrs		<b>Theory</b> Classroom
	2.2 Identify and select tools, equipment and instruments for installation	<ul style="list-style-type: none"> <li>• Purpose of tools, equipment and instruments</li> </ul>			
			<b>Practical</b> 400 Hrs		

	<p>2.3 Demonstrate procedures for mounting solar water heating unit</p>	<ul style="list-style-type: none"> <li>• Suitability of array frame in terms of roof construction</li> <li>• Tilt angle</li> <li>• Fixing methods</li> <li>• Waterproofing measures</li> </ul>			
	<p>2.4 Demonstrate procedures for installing system components</p>	<ul style="list-style-type: none"> <li>• Procedures for installing system components <ul style="list-style-type: none"> <li>- Earthing</li> </ul> </li> <li>• Operational checks <ul style="list-style-type: none"> <li>- Functional tests</li> <li>- Adjustments</li> </ul> </li> <li>• Confirm installation</li> </ul>			

<b>Module 3:</b>	<b>Entrepreneurship</b>					
<b>Objective of the Module:</b>	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> <li>• Plan for own business</li> <li>• Implement financial strategy</li> <li>• Develop marketing strategies</li> </ul>					
<b>Duration:</b>	<b>Total:</b>	<b>160 hours</b>	<b>Theory:</b>	<b>32 hours</b>	<b>Practice:</b>	<b>128 hours</b>
<b>Learning Unit</b>	<b>Learning Outcomes</b>	<b>Learning Elements</b>	<b>Duration (Hours)</b>	<b>Materials Required</b>	<b>Learning Place</b>	
<b>LU-1: Plan for own business</b>	1.1 Identify the importance of entrepreneurs	<ul style="list-style-type: none"> <li>• Types of verbal and non-verbal messages</li> </ul>	<b>Total</b> 53 Hrs	<ul style="list-style-type: none"> <li>• Stationary</li> <li>• Relevant Book</li> <li>• Steel Scale</li> <li>• Pencil</li> <li>• Eraser</li> <li>• Pointers</li> <li>• Highlighter</li> </ul>	<b>Theory</b> Classroom	
	1.2 Identify challenges of being an entrepreneur	<ul style="list-style-type: none"> <li>• Benefits of becoming an entrepreneur</li> </ul>				<b>Theory</b> 11 Hrs
	1.3 Confirm and implement strategies for improving personal entrepreneurship qualities	<ul style="list-style-type: none"> <li>• Features of personal entrepreneurial assessment tools</li> </ul>	<b>Practical</b> 42 Hrs			
	1.4 Select and secure business premises	<ul style="list-style-type: none"> <li>• Business premises requirements</li> <li>• Size, Location, Cost</li> </ul>				
	1.5 Secure business operating clearance	<ul style="list-style-type: none"> <li>• Municipal guidelines and regulations</li> </ul>				
	1.6 Secure business support service	<ul style="list-style-type: none"> <li>• Application procedures</li> </ul>				

<b>LU-2: Implement financial strategy</b>	2.1 Estimate total cost of set up	• Estimation and calculation	<b>Total</b> 53 Hrs		<b>Theory</b> Classroom
	2.2 Identify sources of funding	• Conditions for funding			
	2.3 Estimate business expenses	• Basic accounting principles	<b>Theory</b> 11 Hrs		<b>Practical</b> Lab Workshop Local industry
	2.4 Project profit and loss and cash flow	• Basic accounting principles	<b>Practical</b> 42 Hrs		
	2.5 Establish and follow bank requirements	• General bank requirements			
	2.6 Implement financial control system	• Basic financial concepts			
	2.7 Prepare financial statements and interpret results	• Basic financial concepts			
	2.8 Prepare and implement periodic plans and budgets	• Basic financial concepts			
	2.9 Maintain business cash and general liquidity	• Basic financial concepts			

<b>LU-3: Develop marketing strategies</b>	3.1 Identify potential profitable opportunities and target markets	<ul style="list-style-type: none"> <li>Marketing research tools</li> </ul>	<b>Total</b> 54 Hrs		<b>Theory</b> Classroom
	3.2 Plan service and product delivery	<ul style="list-style-type: none"> <li>Customer expectations and satisfaction</li> </ul>	<b>Theory</b> 12 Hrs		<b>Practical</b> Lab
	3.3 Identify competitors operating in the industry	<ul style="list-style-type: none"> <li>Principles of a competitive market</li> </ul>	<b>Practical</b> 42 Hrs		Workshop
	3.4 Identify methods of promotion	<ul style="list-style-type: none"> <li>Basic promotional and/or marketing concepts</li> </ul>			Local industry

## 4. Assessment guidance

Competency-based assessment is the process of gathering evidence to confirm the candidate's ability to perform according to specified outcomes articulated in the competency standard(s).

### 4.1 Types of assessment

#### a) Sessional assessment

The goal of sessional assessment is to monitor student progress in order to provide constant feedback. This feedback can be used by the trainers to improve their teaching and by learners to improve their learning.

More specifically, sessional assessments help learners to identify their strengths and weaknesses and help trainers to recognise where learners are struggling and address problems immediately.

Examples of sessional assessments include:

- Observations
- Presentations
- Activity sheets
- Project work
- Oral questions

#### b) Summative (final) assessment

The goal of summative (final) assessment is to evaluate learning progress at the end of a training programme by comparing it against, e.g. set of competency standards.

Examples of summative assessments include:

- Direct observation of work activities
- Final project
- Written questions



## **4.2 Principles of assessment**

When conducting assessment or developing assessment tools, trainers/assessors need to ensure that the following principles of assessment are met:

### **Validity**

- Indicates if the assessment outcome is supported by evidence. The assessment outcome is valid if the assessment methods and materials reflect the critical aspects of evidence required by the competency standards (Competency units, performance criteria, knowledge and understanding).

### **Reliability**

- Indicates the level of consistency and accuracy of the assessment outcomes. The assessment is reliable if the assessment outcome will produce the same result for learners with equal competence at different times or places, regardless of the trainer or assessor conducting the assessment.

### **Flexibility**

- Indicates the opportunity for learners to discuss certain aspects of their assessment with their trainer or assessor, such as scheduling the assessment. All learners should be made aware of the purpose of assessment, the assessment criteria, the methods and tools used, and the context and proposed timing of the assessment well in advance. This can be achieved by drawing up a plan for assessment.

### **Fair assessment**

- Fair assessment does not advantage or disadvantage particular learners because of status, race, beliefs, culture and/or gender. This also means that assessment methods may need to be adjusted for learners with disabilities or cultural differences. An assessment should not place unnecessary demands on learners that may prevent them from demonstrating competence.

#### 4.3 Assessment template – Sessional and Summative assessment

Module Title	Learning Units	Recommended form of assessment	
		Sessional	Summative
<b>Module 1:</b> Installation	<b>LU-1:</b> Plan and calculate cost <b>LU-2:</b> Install appliances	<ul style="list-style-type: none"> <li>• Activity sheets</li> <li>• Simulation</li> <li>• Oral and written questions</li> </ul>	Integrated assessment: <ul style="list-style-type: none"> <li>• Project</li> <li>• Demonstration</li> <li>• Role play</li> <li>• Oral and written questions</li> </ul>
<b>Module 2:</b> Solar water heating - Installation	<b>LU-1:</b> Plan and prepare for installing solar water heating system <b>LU-2:</b> Install and commission solar water heating system	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Simulation</li> <li>• Oral and written questions</li> <li>• Demonstration</li> </ul>	
<b>Module 3:</b> Entrepreneurship	<b>LU-1:</b> Plan for own business <b>LU-2:</b> Implement financial strategy <b>LU-3:</b> Develop marketing strategies	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Oral and written questions</li> <li>• Demonstration</li> </ul>	

## 5. List of Tools, Machinery & Equipment

Occupational title		Plumber – Level 3	
Duration		12 months	
Sr. No.	Name of Item/ Equipment / Tools		Quantity
1.	Adjustable wrench 6",8",10",12"		25
2.	Pipe Bender Machine Hydraulic complete set		04
3.	Chisel set		25
4.	Trowel		25
5.	Electric Drill machine(hammering), Electric Drill machine healti		10 each
6.	Die (Ratchet),Die Fix 1/2,3/4,1,2		12 each
7.	Extension board 10 meter 2 core		06
8.	First Aid box		02
9.	Gloves leather, rubber		50 pairs
10.	Safety goggles Plastic, glass		25
11.	Electric Grinder Electric Wall Cutter		5 each
12.	Grip plier 8"		12
13.	Hammer 250gm,500gm,1000gm,1500gm,2000gm		50 each
14.	Hand bit 1/4", 5/16",1/2"		25 each
15.	Helmet ABS Material		25
16.	Hacksaw 12"		25
17.	Spirit Level 6",12",18"		25
18.	L-key set Star L key Set		6 each

19.	Measuring tape 3m,10m	25
20.	Pipe wrench 8",10",12",14",18",24"	25 each
21.	Cutter Pliar	25
22.	PPRC Heater 750W to 1000W	12
23.	PPR/Gi cutter 10" Gi Pipe Cutter ½ to 2"	12
24.	Safety boots(Shoes)	30 pairs
25.	Screw driver set 6",8",10",12"	6 each
26.	Spanner set 6mm to 24mm	6 each
27.	Testing pump (leakage) (Hand type)	4 each
28.	Tools box iron+3 draws	25 each
29.	Torch Chargeable	05
30.	Vice with iron stand(2nos)	10
31.	Compass Spring type 6"	06
32.	Solar Water Heater (Complete Set) Different denominations with different types i.e. pressurized and gravity based thermosyphon.	05 unit
33.	Water Filling Pumps Centrifugal pump ½" Reciprocating 1/2	04 each
34.	Pipe Insulation Material	As required
35.	Sealing Tapes	4 dozen
36.	Bench Vice 5" with bench	12
37.	Oil Can	25
38.	Center Punch	25
39.	Wire Brush	25
40.	Pipe Reemar	06

41.	Tap Set 1/8",1/4",3/8",1/2",3/4",1" with handle	06 each
42.	Air Compressor 10 bar	02 each
43.	Tri square 6",8"	12

## 6. List of Consumable Supplies

Occupational title		Plumber – Level 3	
Duration		12 months	
Sr. No.	Name of Item/ Equipment / Tools	Range	Quantity
1.	Gi Pipe 1/2",3/4",1"		As required
2.	Gi fitting 1/2",3/4",1" (Elbow, tee,socket etc)		As required
3.	PPRC pipe 25mm,32mm		As required
4.	PPRC fitting 25mm,32mm		As required
5.	PVC pipe 2",3",4"		As required
6.	U PVC 2",3",4"		As required
7.	P trap 4"		As required
8.	Solution PVC		As required
9.	All types of valves 1/2"		As required
10.	Plastic Pipe 1/2",3/4",1"		As required
11.	Cp Fitting		As required