PLUMBING

CBT Curriculum

National Vocational Certificate Level 2

Version 1 - December 2014

EUROPEAN UNION
Kingdom of the Netherlands
german cooperation DEUTSCHE ZUSAMMENARBEIT
NORWEGIAN EMBASSY
Supported by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Islamic Republic of Pakistan
اسلامی جمہوریہ پاکستان
Islāmī Jumhūrī-ye Pākistān
NAVTTC

Published by
National Vocational and Technical Training Commission
Government of Pakistan

Headquarter
Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
www.navttc.org

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Layout & design
SAP Communications

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TVET Reform Support Programme

This document has been produced with the technical assistance of the TVET Reform Support Programme, which is funded by the European Union, the Embassy of the Kingdom of the Netherlands, the Federal Republic of Germany and the Royal Norwegian Embassy and has been commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in close collaboration with the National Vocational and Technical Training Commission (NAVTTC) as well as provincial Technical Education and Vocational Training Authorities (TEVTAs), Punjab Vocational Training Council (PVTC), Qualification Awarding Bodies (QABs)s and private sector organizations.

Document Version
December, 2014
Islamabad, Pakistan

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Contents

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(Assistant) who are competent toinstall, 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;
- Follow safe work procedures;
- Perform preventive and corrective maintenance;
- Perform Quality Checks;
- 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;
- Satisfactory completion of appropriate admission assessment test.

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 CBETprogrammes:

- **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 avery 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 Building Electrician (Assistant) – NVQF level 2, consists of six (6) modules. The delivery of the modules (sequence) is suggested as follows:

Module 1: Maintenance
Module 2: Installation, Fitting and Excavation
Module 3: Solar water heating -1
Module 4: Continuing Professional Development

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 4 modules, which will be delivered over 800 hours i.e. six (6) months.
The distribution of training hours is as follows:

a) Total Training hours = 720 Hours
b) Theory = 144 Hours (20%)
c) Practical = 576 Hours (80%)

2. Overview about the programme – Curriculum for Plumber (Assistant) – NVQF Level 2:

Module Title	Learning Units	Theory[1] Days/hours	Workplace[2] Days/hours	Timeframe of modules
Module 1: Maintenance	**LU-1:** Plan and prepare for work **LU-2:** Use tools and equipment **LU-3:** Inspect and troubleshoot plumbing system **LU-4:** Conduct maintenance	**68**	**270**	**338**
Module 2: Installation, Fitting and Excavation	**LU-1:** Plan and prepare for work **LU-2:**Excavate according to plan **LU-3:**Install products	**45**	**180**	**225**
Module 3: Solar water heating - 1	**LU-1:**Describe the benefits of solar water heating **LU-2:**Outline solar water heating system fundamentals	**26**	**106**	**132**
Module 4: Continuing Professional Development	**LU-1:** Identify professional development needs **LU-2:** Develop professional knowledge, skills and attitudes **LU-3:** Maintain professional proficiency	**5**	**20**	**25**

[1]Learning hours in training provider premises
[2]Training workshop, laboratory and on-the-job workplace

3. Plumber(Assistant) – Curriculum Contents

Module 1:	**Maintenance**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Plan and prepare for work • Use tools and equipment • Inspect and troubleshoot plumbing systems • Conduct maintenance				
Duration:	**Total: 338 hours**	**Theory: 68 hours**		**Practice: 270 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Plan and prepare for work**	1.1 Identify and obtain safety and other regulatory requirements for maintenance	• Safety requirements, specifications, Hazard identification	**Total** 70 Hrs **Theory** 14 Hrs **Practical** 56 Hrs		**Theory** Classroom **Practical** Lab Workshop
	1.2 Interpret layout diagrams	• Drawings and symbols specifications			
	1.3 Identify and select tools and equipment	• Tools and equipment and calibration thereof			

LU-2: **Use tools and equipment**	2.1 Identify and select toolsand equipment	• Purpose and application of plumbing tools and equipment	**Total** 90 Hrs **Theory** 18 Hrs **Practical** 72 Hrs		**Theory** Classroom **Practical** Lab Workshop Local industry
	2.2 Demonstration of safe use of hand tools and equipment	• Chip removal forming process • Chip-less forming process • Use of plumbing tools, and equipment includingPPR heater			
	2.3 Perform arc welding	• Safety precautions • Welding equipment • Welding rods • Consumables			
	2.4 Maintain and / or replace tool insulation	• Types of insulation and reports			
	2.5 Clean and store plumbing tools and equipment	• Storage requirements - Tool box - Key lock system - Counting and tagging tools			

LU-3: **Inspect and troubleshoot systems**	3.1 Identify key safety hazards associated with troubleshooting	• Hazards • Inspection requirements • Troubleshooting requirements • Plumbing system knowledge	**Total** 95 Hrs **Theory** 19 Hrs **Practical** 76 Hrs		**Theory** Classroom **Practical** Lab Workshop Local industry
	3.2 Describe the procedures for preventive maintenance	• Preventive maintenance • Types of maintenance schedules or programmes for: - Tools - Equipment - Machinery - Facilities • Identification of faults by checking shape and size of parts • Safety precautions			
	3.3 Analyse system fault	• Component operation in the plumbing system • Document results			

LU-4: **Conduct maintenance**	4.1 Explain the key hazards associated with maintenance	• Identify and obtain safety, hazards and other regulatory requirements for conduct maintenance	**Total** 83 Hrs **Theory** 17 Hrs **Practical** 66 Hrs		**Theory** Classroom **Practical** Lab Workshop Local industry
	4.2 Apply minor adjustments and calibrations	• Cleaning of plumbing equipment • Calibration of plumbing instruments			
	4.3 Replace worn out or damaged parts	• Identification of worn out or damaged parts			
	4.4 Describe the procedures of dismantle faulty parts or components	• Dismantling procedures			
	4.5 Replace or repair faulty parts or components	• Replacing and repairing procedures			
	4.6 Perform commissioning	• Commissioning procedures			

Module 2:	**Installation, Fitting and Excavation**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Plan and prepare for work • Excavate according to plan • Install products				
Duration:	**Total: 225 hours**	**Theory: 35 hours**		**Practice: 190 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Plan and prepare for work**	1.1 Identify and interpret safety and other regulatory requirements	• Safety requirements for assembling - Specifications - Hazard identification • Safety requirements for installation - Specifications - Hazard identification	**Total** 65 Hrs **Theory** 13 Hrs **Practical** 52 Hrs	•	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Identify and select the tools and equipment for work	• Types of tools, equipment and material			
	1.3 Interpret and confirm layout plan	• Drawings and symbols • Specifications			
	1.4 Perform measurements	• Measuring units and conversions			
	1.5 Mark out excavation	• Procedures for marking out			

LU-2: **Excavate according to plan**	2.1 Identify safety hazards and risks	• Risk and hazard identification	**Total** 80 Hrs **Theory** 16 Hrs **Practical** 64 Hrs		**Theory** Classroom **Practical** Lab Workshop Local industry
	2.2 Perform excavation	• Excavation procedures andtechniques related to plumbingwork • Safety precautions			
	2.3 Install trench support	• Methods of trench support			
	2.5Clean up and store tools, equipment and materials	• Waste disposal procedures • Care of tools and equipment			
LU-3: **Install product**	3.1 Identify safety hazards and risks	• Risk and hazard identification	**Total** 80 Hrs **Theory** 16 Hrs **Practical** 64 Hrs		**Theory** Classroom **Practical** Lab Workshop Local industry
	3.2 Mark out installation points and fixtures	• Procedures for marking out • Type of fixtures			
	3.3 Mount sanitary ware	• Leveling procedures			
	3.4 Perform quality inspection	• Importance of quality • Handing over to client • Completing documents			

Module 3:	**Solar water heating- 1**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Describe the benefits of PV systems • Outline PV system fundamentals • Describe off-grid PV systems • Maintain off-grid PV systems and components				
Duration:	**Total: 132 hours**	**Theory: 26 hours**		**Practice: 106 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Describe the benefits of solar waterheating**	1.1 Explain the advantages of solar water heating	• Thermalpower generation and environmental benefits - No greenhouse gases, no harmful emission - No air pollution - No soil damage - No noise • Natural way to produce energy • Easy installation and little maintenance (cost) • Long life timespan	**Total** 66 Hrs **Theory** 13 Hrs **Practical** 53 Hrs		**Theory** Classroom **Practical** Lab Workshop
	1.2 Explain the disadvantages of solar water heating	• Dependant on sun light • Initial cost			

LU-2: **Outlinesolar water heating system fundamentals**	2.1 Define the term ‘solar thermal’	• Definition of ‘solar thermal’	**Total** 66 Hrs **Theory** 13 Hrs **Practical** 53 Hrs		**Theory** Classroom **Practical** Lab Workshop
	2.2 Describe the basic function of domestic solar water heating	• Solar system effect • Principles of heating			
	2.3 Distinguish between different water heating systems	• Open loop system • Close loop system • Passive system • Active system			
	2.4 Identify the components in a solar water heating system	• Solar evacuated glass tubes • Hot water storage tank • Support structure (Frame) • Fittings, pipes and valves • Safety valves - Expansion vessels - Air vents • Electric/Gas backup heating (Element) • Circulation and water filling pump • Control instruments • Pipe insulation material			
	2.5 Describe hazards associated with solar water heating installation and maintenance	• Regulatory requirements for conducting maintenance			

Module 4:	**Apply continuing professional development**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Identity professional development needs • Develop professional knowledge, skills and attitudes • Maintain professional proficiency				
Duration:	**Total: 25 hours**	**Theory: 5 hours**		**Practice: 20 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Identity professional development needs**	1.1 Discuss professional development needs	• Reason s for professional development	**Total** 5 Hrs **Theory** 5 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Identify professional development programmes	• Access to programmes • Career guidance			

LU-2: **Develop professional knowledge, skills and attitudes**	2.1 Participate in training programmes	• Outcomes and relevance of training	**Total** 10 Hrs **Theory** 2 Hrs (Practical) 8 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab Workshop Local industry
	2.2 Document training outcome	• Report and portfolio writing			
LU-3: **Maintain professional proficiency**	3.1 Identify and use self-study sources	• Research methods • Access to sources	**Total** 10 Hrs **Theory** 2 Hrs (Practical) 8 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab
	3.2 Implement self-study plan	• Planning your career			

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 ofsessional 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**
Module 1: Maintenance	**LU-1:** Plan and prepare for work **LU-2:** Use tools and equipment **LU-3:** Inspect and troubleshoot plumbing system **LU-4:** Conduct maintenance	• Activity sheets • Simulation • Oral and written questions	Integrated assessment: • Project • Demonstration • Role play • Oral and written questions
Module 2: Installation, Fitting and Excavation	**LU-1:** Plan and prepare for work **LU-2:**Excavate according to plan **LU-3:**Install products	• Observation • Simulation • Oral and written questions • Demonstration	
Module 3: Solar water heating - 1	**LU-1:**Describe the benefits of solar water heating **LU-2:**Outline solar water heating system fundamentals	• Observation • Oral and written questions • Demonstration	
Module 4: Continuing Professional Development	**LU-1:** Identify professional development needs **LU-2:** Develop professional knowledge, skills and attitudes **LU-3:** Maintain professional proficiency	• Observation • Simulation • Oral and written questions • Demonstration	

5. List of Tools, Machinery & Equipment

Occupational title	Plumber (Assistant) – Level 2	
Duration	6 months	
Sr. No.	**Name of Item/ Equipment / Tools**	**Quantity**
1.	Adjustable wrench 6”,8”,12”	25
2.	Pipe Bender Machine Hydraulic complete set	04
3.	Chisel set	25
4.	Trowel	25
5.	Electric Drill machine(hammering with healti)3/4”	10
6.	Die (Ratchet),Die Fix 1/2,3/4,1,2	6 each
7.	Extension board 10 meter 2 core	06
8.	First Aid box	02
9.	Gloves lather,rubber	50 pairs
10.	Safety goggles Plastic,glass	25
11.	Hand Electric Grinder Electric Wall Cutter	5 each
12.	Grip plier 10”	12
13.	Hammer 250gm,500gm,1000gm,1500gm,2000gm	25 each
14.	Hand bit ¼” , 3/8”	25 each
15.	Helmet ABS Material	25
16.	Hacksaw 12” with blade	25
17.	Spirit Level 6”,12”,8”	25
18.	L-key set Star L key Set	6 each

19.	Measuring tape 3meter ,10 meter	25
20.	Pipe wrench ,10”,12”,14”,18”	25 each
21.	Plass (pipe cutter) ½”, 2”	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 nos
28.	Tools box iron+3 draws	25 nos
29.	Torch Chargeable	05
30.	Vice with iron stand(2nos)	10
31.	Compass Spring type 8”	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” Receprocating 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
43.	Tri square 6”,8”	12

6. List of Consumable Supplies

Occupational title	**Plumber – Level 2**		
Duration	**12 months**		
Sr. No.	**Name of Item/ Equipment / Tools**	**Range**	**Quantity**
1.	Gi Pipe ½”,3/4”,1”		As required
2.	Gi fitting ½”,3/4”,1” (Elobow, 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 ½”,3/4”,1”		As required
10.	Plastic Pipe ½”,3/4”,1”		As required
11.	Cp Fitting		As required

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