



COMPETENCY BASED CURRICULUM (Commercial Heating Ventilation and Airconditioning)

CERTIFICATE-3



Technical Trainers Training and Resource Center
Department of Workforce Planning and Skills Development
Ministry of Education and Skills Development

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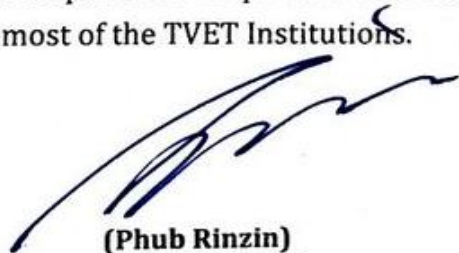
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FOREWORD

Bhutan has seen a gradual increase in the requirement of skilled workers in recent years due to growth of industries. However, supply of skilled workforce that are responsive to the needs of the industry has not been able to keep in pace with the industry demand. Since the skilled workers are crucial ingredient for socio-economic development of the country, it is important to have adequate number of trained and certified workers. With growing industries, the "Commercial Heating Ventilation and Air Conditioning Technician" are not only the most significant occupation but also have high demand in the labour market. In an effort to meet the skilled human resources requirement in the area of Commercial HVAC, it is imperative to deliver training based on Competency Based Training system in Heating Ventilation and Air Conditioning to ensure quality and adequate number of workforces in this sector.

To this end, the Department of Work Force Planning and Skills Development (DWPSD) is pleased to present the second edition of Competency Based Curriculum for Commercial Heating Ventilation and Air Conditioning Technology BQF-C3 course developed based on revised National Competency Standards (NCS) and using standard curriculum development guidelines. Since it is an outcome of a more participatory process of curriculum development, it is expected to provide training delivery with reformed approaches having its content being directly related to labour market needs, focusing on imparting of skills and assessment based on industry work standards. We believe that the Competency Based Curriculum will help in bridging the skill gap between industry's needs and training institutes thereby enhance the employability of the technical graduates.

The Department acknowledges the valuable contributions made by institutes, officials, and experts from relevant industries who were involved in the design, development and revision of this curriculum. As it is a dynamic document which may require revision based on the needs of the changing labour market and technology, the Department look forward to receiving valuable feedbacks from the institutes and the industries to further improve and refine the curriculum. The Department hope that this document will help advance Competency Based Learning in most of the TVET Institutions.



(Phub Rinzin)
Director General

Department of Work Force Planning and Skills Development

ACKNOWLEDGEMENT

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COMPETENCY PROFILE
Trade: Commercial HVAC BQF-C3

Competency Area	Sub- Competency Area	Competencies/Tasks 			
A. Carry out installation and servicing of commercial refrigeration system (Cold storage room)	A1. Perform installation of commercial refrigeration system	A1.01 Perform site inspection	A1.02 Perform estimation and costing	A1.03 Prepare installation layout	A1.04 Install indoor unit
		A1.05 Install outdoor unit	A1.06 Perform leak test	A1.07 Perform vacuuming	A1.08 Charge refrigerant
		A1.09 Perform commissioning			
	A2. Perform servicing of commercial refrigeration system	A2.01 Service refrigerator controller	A2.02 Service defrost component	A2.03 Replace compressor component	A2.04 Replace condensing fan unit
		A2.05 Service condenser	A2.06 Replace expansion valve	A2.07 Replace pressure switch	A2.08 Service evaporator unit
		A2.09 Service commercial refrigerator door	A2.10 Perform refrigerant recovery/pump down	A2.11 Perform flushing	A2.12 Perform vacuuming
		A2.13 Charge refrigerant	A2.14 Perform testing of refrigeration system		
	A3. Troubleshoot faults of commercial refrigeration system	A3.01 Diagnose electrical faults	A3.02 Diagnose mechanical faults	A3.03 Prepare report	

Competency Area	Sub- Competency Area	Competencies/Tasks 			
B. Carry out installation and servicing of VRF/VRV system	B1. Perform installation of VRF/VRV system	B1.01 Perform site inspection	B1.02 Perform estimation and costing	B1.03 Prepare installation layout	B1.04 Install indoor unit
		B1.05 Layout communication wires	B1.06 Perform coper tube layout/drainage pipe layout	B1.07 Install outdoor unit	B1.08 Perform leak test
		B1.09 Perform vacuuming	B1.10 Charge refrigerant	B1.11 Perform commissioning	
	B2. Perform servicing of VRF/VRV system	B2.01 Perform refrigerant recovery/pump down	B2.02 Service compressor component	B2.03 Service condensing unit	B2.04 Replace sensors
		B2.05 Replace solenoid valve	B2.06 Service drain-out pump	B2.07 Service evaporator component	B2.08 Replace pressure switch
		B2.09 Replace expansion valve	B2.10 Perform flushing	B2.11 Perform vacuuming	B2.12 Recharge refrigerant
	B3. Troubleshoot faults of VRF/VRV system	B3.01 Diagnose electrical faults	B3.02 Diagnose mechanical faults	B3.03 Prepare report	
C. Carry out installation and servicing of commercial chiller/heat pump system	C1. Perform installation of chiller/heat pump system	C1.01 Perform site inspection	C1.02 Perform estimation and costing	C1.03 Prepare installation layout	C1.04 Install outdoor unit
		C1.05 Install Air Handling Unit (AHU)	C1.06 Install Fan Coil Unit (FCU)	C1.07 Install air ducts	C1.08 Install Water Supply and Return pipe lines
		C1.09 Install water pump and water tank	C1.10 Perform refrigerant leak test	C1.11 Perform hydrostatic test	C1.12 Perform vacuuming

Competency Area	Sub- Competency Area	Competencies/Tasks 			
		C1.13 Charge refrigerant	C1.14 Perform commissioning		
	C2. Perform servicing of chiller/heat pump system	C2.01 Perform pump down/refrigerant recovery	C2.02 Service compressor component	C2.03 Service condensing unit	C2.04 Service water pump
		C2.05 Service AHU	C2.06 Service FCU	C2.07 Perform flushing	C2.08 Perform vacuuming
		C2.09 Recharge refrigerant			
	C3. Troubleshoot faults of chiller/heat pump system	C3.01 Diagnose electrical faults	C3.02 Diagnose mechanical faults	C3.03 Prepare report	

COURSE INFORMATION

COURSE TITLE	Commercial Heating Ventilation and Airconditioning
LEVEL	BQF Certificate Level 3
COURSE OBJECTIVE	Upon completion of Commercial Heating Ventilation and Air Conditioning BQF-C3, the trainee will be able to: • Carry out installation and servicing of commercial refrigeration system (Cold Storage Room) • Carry out installation and servicing of VRF/VRV system, and • Carry out installation and servicing of commercial chiller/heat pump system
COURSE DESCRIPTION	This course is designed to provide learners the knowledge, skills and attitude to become competent Commercial HVAC technician in accordance with industry standards. Upon completion of this course, the graduates will be able to work in industries where they can perform duties like carrying out installation & servicing of commercial refrigeration system, VRF/VRV system and commercial chiller system. To obtain the qualification of Commercial Heating Ventilation and Air Conditioning (HVAC) BQF-C3, all learning outcomes prescribed for this qualification must be achieved.
TOTAL DURATION	876 Hours
TRAINING PROPORTION	1:12 (Practical) 1:20 (Theory)
ENTRY REQUIREMENT	Completed RAC BQF Certificate 2
TRAINER QUALIFICATION	• Must have undergone Training of Trainers-Technical Instruction and Andragogy • Must have a minimum qualification of diploma in mechanical/electrical OR Commercial HVAC BQF-C3 with minimum two years of working experience in relevant field • Must have at least 3 years job/industry experience if institute hires a guest lecturer from industry.

COURSE OUTLINE

Sl. No	Subject /Module	Duration (Hours)	Content Competencies (Mapped)
1.	Core modules	298	CC
2.	OJT	280 (2Months)	CC
3.	Applied Dzongkha	42	SS
4.	ICT	48	SS
5.	Applied Mathematics	53	SS
6.	Technical English	51	SS
7.	Engineering Drawing	34	
8.	Assessment	70	
	Total Course Duration	876	

Note: (*) This curriculum contains core modules which cover main competencies of Commercial Heating Ventilation and Air Conditioning BQF-C3 and OJT component. There are separate curricula for subjects/modules for delivery of soft skills, professional development & values and environmental concern & safety. In order to achieve the qualification of Commercial Heating Ventilation and Air Conditioning BQF-C3, the subjects and modules listed must be accomplished as per the credit hours provided.

Content Competencies:

CC-Core Competencies

SS-Soft Skills

PD-Professional Development and Values

ES-Environmental concern and Safety

COURSE STRUCTURE FOR CORE COMPETENCIES

Training Modality	Module Title	Learning outcomes	Nominal Duration (Hours)
1. Institute Training	1.1 Carrying out installation and servicing of commercial refrigeration system	1.1.1 Perform installation of commercial refrigeration system 1.1.2 Perform servicing of commercial refrigeration system 1.1.3 Troubleshoot faults of commercial refrigeration system	101.5
	1.2 Carrying out installation and servicing of VRF/VRV system	1.2.1 Perform installation of VRF/VRV system 1.2.2 Perform servicing of VRF/VRV system 1.2.3 Troubleshoot faults of VRF/VRV system	94
	1.3 Carrying out installation and servicing of commercial chiller system	1.3.1 Perform installation of chiller system 1.3.2 Perform servicing of chiller system 1.3.3 Troubleshoot faults of chiller system	90.5
2. On the Job Training	2.1 Carrying out installation and servicing of commercial refrigeration system	2.1.1 Perform installation of commercial refrigeration system 2.1.2 Perform servicing of commercial refrigeration system 2.1.3 Troubleshoot faults of commercial refrigeration system	280 (2Months)
	2.2 Carrying out installation and servicing of VRF/VRV system	2.2.1 Perform installation of VRF/VRV system 2.2.2 Perform servicing of VRF/VRV system 2.2.3 Troubleshoot faults of VRF/VRV system	
	2.3 Carrying out installation and servicing of commercial chiller system	2.3.1 Perform installation of chiller system 2.3.2 Perform servicing of chiller system 2.3.3 Troubleshoot faults of chiller system	

ASSESSMENT AND CERTIFICATION

ASSESSMENT

Diagnostic assessment of each skill will be conducted to identify areas where trainees may require additional support or intervention. This assessment will also evaluate their existing knowledge, skills, and understanding prior to a specific learning experience or unit of study. Methods such as pre-tests, concept mapping, KWL charts, and observations of student work will be utilized.

Formative assessment for every module and learning outcome will be conducted through assignments, project works, continuous assessment, demonstration of practical skills/observations, oral questioning and written test.

Summative assessment after completion of each national certificate level will be conducted by TVET Quality Council, Bhutan Qualifications and Professional Certification Authority (BQPCA), MoESD as per the National Competency Standards and Guidelines for National Assessment and Certification System, provided the course is accredited with TVET Quality Council, Bhutan Qualifications and Professional Certification Authority, MoESD.

CERTIFICATION

On successful completion of every module, the institute will award a certificate of achievement to the trainees. The TVET Quality Council, Bhutan Qualifications and Professional Certification Authority, MoESD will award a BQF Certificate to the trainees upon the successful completion of BQF Certificate level assessment.

COURSE DELIVERY

1. Modular
2. Demonstration
3. Lecture
4. Discussion
5. Industrial visits
6. Project based learning
7. Problem based learning

RESOURCES

Tools

- Allen key set, screwdriver set, spirit level, bending tools, brazing tools set, capillary tube cutter, concrete hole saw, crimping tool, deburring tool, drill bit set, flame deflector, flaring tool set, hammer, tub cutter, lighter, pliers, tester, spanner set, swaging

tool set, wire stripper, wrench set, adjustable wrench, masonry hand tool set, plumbing hand tool set, tin snips, flashlight, inspection mirror, fin comb and high-pressure water hose

Materials

- Control panel, MDB unit, marker, PCB, PVC dowels, PVC insulation, Pen, aluminum, bearing, brazing torch, compressor, compressor overload protector, compressor relay, condenser, condenser coil, condensing fan unit, copper tube, defrost heater component, dowels, dry nitrogen gas, duct connectors and flanges, duct tape and sealants, galvanized steel, elbow joints, emery paper, evaporator, expansion valve, fan motor, fasteners, filler rod, filter drier, floor heating pipe, flux, gasket, heat exchanger, impeller, indoor unit, insulation for ducts, insulation sheet, insulation tape, insulator, lubricant, markin cloth, logbook, notepad, nut & bolts, outdoor unit, elbows, process tube, pump, receiver drier, reducers, refrigerant, screws, shaft, sheet metal, soap solution, strainer, tees, teflon tape, thermos-fuse and capacitor, thermostat, thimble, timer, valves, washers, water pump, weather proof wrapping tape, refnet and wires

Instruments

- Clamp-on meter, Phase sequence meter, weighing scale, air flow meter, calculator, leak detector, manifold gauge set, measuring tape, pressure gauge, micron gauge, thermometer, data logger, sprit level gauge, tachometer and decibel meter

Equipment

- AHU, commercial refrigerator, computer, drilling machine, FCU, air compressor, welding machine, brazing set, dry nitrogen gas cylinder set, vacuum pump, indoor and outdoor unit, recovery cylinder, recovery machine, VRF/VRV system, cutting machine, crane, lock forming machine, bending machine, test pump, chiller controller, condensing unit, chiller system, water pump, electric blower, vacuum cleaner, and fan coil unit.

PPE

- Safety gloves, safety boots, safety belt, safety helmet, workshop dress, respiratory mask and safety goggles

Learning materials

- Reference books
- Hand-outs
- Audio visuals
- Competency Based Learning materials (CBLM)

Infrastructure and training facilities

- ***Theory classroom size:*** Minimum of 1 square meter per person
- ***Practical Workshop size:*** Minimum of 2.25 m² per student. Variables must be considered dependent upon type of skills being taught and the number of students being participated at one time.

MODULE INFORMATION: COMMERCIAL HEATING VENTILATION AND AIR CONDITIONING BQF-C3

MODULE 1: CARRYING OUT INSTALLATION AND SERVICING OF COMMERCIAL REFRIGERATION SYSTEM (COLD STORAGE SYSTEM)

MODULE INFORMATION

Occupation	HVAC Technician
Competency Area	Carry out installation and servicing of commercial refrigeration system (Cold storage system)
Module Title	Carrying out installation and servicing of commercial refrigeration system (Cold storage system)
Module Code	7127-L3-M1
Module Description	This module is structured to provide learners the knowledge, skills and right attitude required to perform installation & servicing of commercial refrigeration system and troubleshoot faults of commercial refrigeration system
Nominal Duration	101.5 Hours
Certificate Level	BQF Certificate Level 3
Pre-requisite	Completed RAC BQF-C2
Learning Outcome	1. Perform installation of commercial refrigeration system 2. Perform servicing of commercial refrigeration system 3. Troubleshoot faults of commercial refrigeration system

Module Title	Carrying out installation and servicing of commercial refrigeration system (Cold storage system)		
Module Code	7127-L3-M1		
Learning Outcome 1	Perform installation of commercial refrigeration system		
Duration	Theory:8 hours	Practical: 43 hours	Total: 51 hours
Assessment Criteria	• Site inspection is performed as per the job requirement following standard procedure • Estimation and costing are performed as per job requirement following standard procedure • Installation layout is prepared as per the job requirement following standard procedure • Indoor unit is installed as per the job requirement following standard procedure • Outdoor unit is installed as per the job requirement following standard procedure • Leak test is performed as per the job requirement following standard procedure • Vacuuming is performed as per the standard procedure • Refrigerant is recharged as per the job requirement following standard procedure • Commissioning is performed as per the standard operating procedure		
Content	A1.00 Introductory knowledge • Introduction to Commercial HVAC • Market trends and scope of HVAC technician • Fundamentals of refrigeration cycle A1.01 Performing site inspection <i>Knowledge</i> • Purpose of site selection <i>Skills</i> • Analytical skills • Communication skills • Observation skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity		

	• Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.02 Perform estimation and costing <i>Knowledge</i> • Definition of estimation and costing • Purpose of estimation and costing <i>Skills</i> • Basic ICT skills • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to get the price of the materials from genuine suppliers A1.03 Preparing installation layout <i>Knowledge</i> • Introduction to cold storage system • Purpose of preparing installation layout • Calculation of cooling load • Types of insulation wall panel <i>Skills</i> • Using drilling machine • Using spirit level • Interpreting drawing • Numeracy skills • Analytical skills • Communication skills
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	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.04 Installing indoor unit <i>Knowledge</i> • Types of indoor unit • Components of indoor unit • Definition of humidity • Importance of insulating pipes and power cable <i>Skills</i> • Analytical skills • Communication skills • Observation skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.05 Installing outdoor unit <i>Knowledge</i> • Components of outdoor unit • Importance of site selection for installing outdoor unit <i>Skills</i> • Using drilling machine • Using spirit level • Using flaring and swaging tool
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	• Using tube bender • Analytical skills • Communication skills • Observation skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.06 Performing leak test <i>Knowledge</i> • Purpose of leak test • Symptoms, causes and remedies of leakage • Importance of nitrogen pressure test <i>Skills</i> • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.07 Performing vacuuming <i>Knowledge</i> • Purpose of vacuuming • Function of service valve • Types of vacuum pump
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	• Methods of vacuuming <i>Skills</i> • Using vacuum pump • Using manifold gauge • Using micron gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A1.08 Charging refrigerant <i>Knowledge</i> • Definition of refrigerant • Classification of refrigerants • Safety designation of refrigerant • Methods of charging <i>Skills</i> • Using digital weighing scale • Using manifold gauge • Using charging machine • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE
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	• Ensuring proper disposal of waste A1.09 Performing commissioning Knowledge • Purpose of commissioning Skills • Analytical skills • Communication skills Attitude, safety and environment concern • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio Visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • IT lab with internet facilities • Library • Workshop Tools • Ladder, spirit level, drill bit set, screwdriver set, concrete hole saw, spanner set, tube cutter, flaring tools set and pliers Materials • Pen, notepad, marker, screws, nut & bolts, dowels, flux, filler rod, lighter, copper tube, markin cloth, insulator sheet, silicon sealant, dry nitrogen gas, brazing torch, process tube, soap solution, refrigerant and checklist

	Instruments • Multimeter, measuring tape, digital weighing scale, micron gauge, manifold gauge set and leak detector Equipment • Drilling machine, refrigerant charging machine, brazing set, dry nitrogen gas cylinder set, vacuum pump, indoor and outdoor unit PPE • Safety gloves, safety belt, safety helmet, safety boots, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carrying out installation and servicing of commercial refrigeration system (Cold storage system)		
Module Code	7127- L3-M1		
Learning Outcome 2	Perform servicing of commercial refrigeration system		
Duration	Theory: 9 hours	Practical: 32 hours	Total: 41hours
Assessment Criteria	- Refrigerator controller is serviced as per the job requirement following standard procedure - Defrost component is serviced as per the job requirement following standard procedure - Compressor component is replaced as per the job requirement following standard procedure - Condenser fan is replaced as per the job requirement following standard procedure - Condenser is serviced as per the job requirement following standard procedure - Expansion valve is replaced as per the job requirement following standard procedure - Pressure switch is replaced as per the job requirement following standard procedure - Evaporator unit is serviced as per the job requirement following standard procedure - Commercial refrigerator door is serviced as per the job requirement following standard procedure - Refrigerant is recovered/pump down is performed as per the job requirement following standard procedure - Flushing is performed as per the job requirement following standard procedure - Vacuuming is performed as per the job requirement following standard procedure - Refrigerant is charged as per the job requirement following standard procedure - Testing of refrigeration system is performed as per the job requirement following standard procedure		
Content	A2.01 Servicing commercial refrigerator controller <i>Knowledge</i> - Definition of controller - Electrical/electronic components and their functions - Identification of electrical phase		

	<i>Skills</i> • Using multimeter • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A2.02 Servicing defrost component <i>Knowledge</i> • Introduction to defrost system • Types of defrost system • Working principle of defrost system <i>Skills</i> • Using multimeter • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
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	A2.03 Replacing compressor component <i>Knowledge</i> • Function of compressor • Types of compressors • Components of compressor • Operation of compressor <i>Skills</i> • Using multimeter • Brazing skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A2.04 Replacing condensing fan unit <i>Knowledge</i> • Function of condenser fan unit • Operation of condenser fan unit <i>Skills</i> • Using multimeter • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE
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	• Ensuring proper disposal of waste A2.05 Servicing condenser <i>Knowledge</i> • Function of condenser • Types of condensers <i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Brazing skills • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas A2.06 Replacing expansion valve <i>Knowledge</i> • Function of expansion valve • Types of expansion valve • Operation of expansion valve <i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Brazing skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious
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	• Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas A2.07 Replacing pressure switch <i>Knowledge</i> • Function of pressure switch • Types of pressure switch • Operation of pressure switch <i>Skills</i> • Interpreting circuit diagram • Using recovery machine • Using manifold gauge • Using weighing scale • Brazing skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas A2.08 Servicing evaporator unit <i>Knowledge</i> • Function of evaporator • Symptoms, causes and remedies of faulty evaporator
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	<i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Brazing skills • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas A2.09 Servicing refrigerator door <i>Knowledge</i> • Components of refrigerator door • Function of emergency switch • Purpose of servicing refrigerator door <i>Skills</i> • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
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	A2.10 Performing refrigerant recovery /pump down <i>Knowledge</i> • Purpose of refrigerant recovery/pump down • Effects of refrigerant on environment • Methods of refrigerant recovery <i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A2.11 Performing flushing <i>Knowledge</i> • Purpose of flushing • Purpose of using dry nitrogen gas <i>Skills</i> • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE
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	• Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas A2.12 Performing vacuuming <i>Knowledge</i> • Function of vacuum pump • Purpose of vacuuming <i>Skills</i> • Using manifold gauge • Using micron gauge • Observation skills • Communication skills • Analytical skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A2.13 Charging refrigerant <i>Knowledge</i> • Effects of overcharging and under charging • Importance of liquid and vapour charging <i>Skills</i> • Using digital weighing scale • Using manifold gauge • Using charging machine • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience
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	• Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A2.14 Performing testing of refrigeration system <i>Knowledge</i> • Purpose of performing refrigeration system test <i>Skills</i> • Using thermometer • Using data logger • Using clamp meter • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop

	Tools • Screwdriver set, pliers, Allen key set, wrench set, flame deflector, flaring tool set, socket set, valve key and tester Materials • Controller panel, MDB unit, weather proof wrapping tape, defrost heater component, PVC insulation, screws, compressor, relay, refrigerant, wires, thimble, insulation tape, flux, lighter, markin cloth, pen, notepad, condensing fan unit, receiver drier, filler rod, copper tube, dry nitrogen gas, emery paper, condenser coil, expansion valve, soap solution, evaporator, brazing torch, process tube, timer, thermostat, PCB, fan motor, thermo fuse and capacitor Instruments • Clamp-on meter, manifold gauge set, weighing scale, thermometer, micron gauge, leak detector and data logger Equipment • Cold storage room, refrigerator controller, recovery cylinder, recovery machine, brazing set and vacuum pump PPE • Safety gloves, safety boots, safety belt, safety helmet, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carrying out installation and servicing of commercial refrigeration system (Cold storage system)		
Module Code	7127-L3-M1		
Learning Outcome 3	Troubleshoot faults of commercial refrigeration system		
Duration	Theory: 2.5 hours	Practical: 7 hours	Total: 9.5 hours
Assessment Criteria	- Electrical faults are diagnosed as per the job requirement following standard procedure - Mechanical faults are diagnosed as per the standard procedure - Report is prepared as per the job requirement following standard procedure		
Contents	A3.01 Diagnosing electrical faults <i>Knowledge</i> - Symptoms, causes and remedies of electrical faults <i>Skills</i> - Using multimeter - Observation skills - Analytical skills - Communication skills - Problem-solving skills <i>Attitude, safety and environment concern</i> - Being time conscious - Being efficient in using resources - Being a team player - Having work ethics and integrity - Having patience - Proper handling of tools, materials, instrument and equipment - Ensuring to follow OHS rules and regulations - Ensuring appropriate use of PPE - Ensuring proper disposal of waste A3.02 Diagnosing mechanical faults <i>Knowledge</i> - Symptoms, causes and remedies of mechanical faults <i>Skills</i> - Using pressure gauge - Observation skills - Analytical skills - Communication skills - Problem-solving skills <i>Attitude, safety and environment concern</i> - Being time conscious		

	• Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste A3.03 Preparing report Knowledge • Importance of documentation and record keeping Skills • Basic ICT skills • Documentation skills • Analytical skills • Communication skills Attitude, safety and environment concern • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books Learning facilities and infrastructures • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop Tools

	• Screwdriver set, plier and tester Materials • Overload relay, timer, thermostat, PCB, fan motor, thermo-fuse, capacitor, cold room catalogue, paper and pencil Equipment • Cold storage and computer Instruments • Multimeter, calculator, clamp-on meter, manifold gauge set and leak detector PPE • Safety gloves, safety boots, safety belt, safety helmet, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

MODULE 2: CARRYING OUT INSTALLATION AND SERVICING OF VARIABLE REFRIGERANT FLOW (VRF)/VARIABLE REFRIGERANT VOLUME (VRV) SYSTEM

MODULE INFORMATION

Occupation	HVAC Technician
Competency Area	Carry out installation and servicing of Variable Refrigerant Flow (VRF)/Variable Refrigerant Volume (VRV) system
Module Title	Carrying out installation and servicing of VRF/VRV system
Module Code	7127-L3-M2
Module Description	This module is structured to provide the learners with knowledge, skills and right attitude required to perform installation & servicing of VRF/VRV system and troubleshoot faults VRF/VRV system
Nominal Duration	94 Hours
Certificate Level	BQF Certificate Level 3
Pre-requisite	Completed Module: 7127-L3-M1
Learning Outcome	1. Perform installation of VRF/VRV system 2. Perform servicing of VRF/VRV system 3. Troubleshoot faults of VRF/VRV system

Module Title	Carrying out installation and servicing of VRF/VRV system		
Module Code	7127-L3-M2		
Learning Outcome 1	Perform installation of VRF/VRV system		
Duration	Theory:6 hours	Practical: 52 hours	Total:58 hours
Assessment Criteria	• Site inspection is performed as per the job requirement following standard procedure • Estimation and costing are performed as per job requirement following standard procedure • Installation layout is prepared as per the job requirement following standard procedure • Indoor unit is installed as per the job requirement following standard procedure • Wire communication is laid out as per the job requirement following standard procedure • Copper tube layout/drainage pipe layout is performed as per the job requirement following standard procedure • Outdoor unit is installed as per the job requirement following standard procedure • Leak test is performed as per the job requirement following standard procedure • Vacuuming is performed as per the standard procedure • Refrigerant is recharged as per the job requirement following standard procedure • Commissioning is performed as per the standard operating procedure		
Contents	B1.01 Performing site inspection <i>Knowledge</i> • Introduction to VRF/VRV system • Types of VRF/VRV system • Operation of VRF/VRV system • Application of VRF/VRV system • Purpose of site selection <i>Skills</i> • Observation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player		

	• Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.02 Performing estimation and costing <i>Knowledge</i> • Definition of estimation and costing • Purpose of estimation and costing <i>Skills</i> • Basic ICT skills • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to get the price of the materials from genuine suppliers B1.03 Preparing installation layout <i>Knowledge</i> • Purpose of preparing installation layout • Calculation of cooling and heating load <i>Skills</i> • Using drilling machine • Using spirit level • Interpreting drawing • Numeracy skills • Observation skills • Analytical skills • Communication skills
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	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.04 Installing indoor unit <i>Knowledge</i> • Types of indoor unit • Components of indoor unit • Importance of insulating pipes and power cable <i>Skills</i> • Brazing skills • Using drilling machine • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.05 Laying out communication wires <i>Knowledge</i> • Purpose of communication wires • Wire size and its importance <i>Skills</i> • Using clamp meter • Interpreting circuit diagram • Analytical skills • Communication skills
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	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to connect the wires as per the circuit diagram B1.06 Performing copper tube layout/drainage pipe layout <i>Knowledge</i> • Types of copper tubes • Types of fittings and joints <i>Skills</i> • Interpreting drawing • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.07 Installing outdoor unit <i>Knowledge</i> • Components of outdoor unit • Importance of site selection ➤ Location ➤ Drainage ➤ Accessibility <i>Skills</i> • Analytical skills
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	• Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.08 Performing leak test <i>Knowledge</i> • Purpose of leak test <i>Skills</i> • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.09 Performing vacuuming <i>Knowledge</i> • Purpose of vacuuming <i>Skills</i> • Using vacuum pump • Using manifold gauge • Using micron gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious
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	• Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.10 Charging refrigerant <i>Knowledge</i> • Methods of charging in VRF/VRV system • Refrigerant charging calculation <i>Skills</i> • Using weighing scale • Using manifold gauge • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B1.11 Performing commissioning <i>Knowledge</i> • Purpose of commissioning <i>Skills</i> • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity
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	• Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop Tools • Spirit level, drill bit set, screwdriver set, concrete hole saw, spanner set, tube cutter, flaring tools set, pliers, wire stripper, tester, bending tools, flaring tools, brazing tools set, deburring tool, hammer and tub cutter Materials • Pen, notepad, marker, screws, dowels, flux, filler rod, lighter, copper tube, markin cloth, insulator sheet, outdoor unit, silicon sealant, dry nitrogen gas, brazing torch, process tube, indoor unit, soap solution, refrigerant, checklist, insulation tape, wires, hanger or C-clamp, fastener, CPVC/PVC pipe, CPVC glue and fittings Instruments • Multimeter, micron gauge, manifold gauge set, weighing scale, leak detector, sprit level gauge and measuring tape Equipment • Drilling machine, brazing set, dry nitrogen gas cylinder set, vacuum pump, VRF/VRV unit, ladder/ scaffolding and speed cutter

	PPE • Safety gloves, safety belt, safety helmet, safety boots, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i> , the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i> , the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carry out installation and servicing of VRF/VRV system		
Module Code	7127-L3-M2		
Learning Outcome 2	Perform servicing of VRF/VRV system		
Duration	Theory: 6.5 hours	Practical: 20 hours	Total: 26.5 hours
Assessment Criteria	• Refrigerant recovery/pump down is performed as per the job requirement following standard procedure • Compressor component is serviced as per the job requirement following standard procedure • Condensing unit is serviced as per the job requirement following standard procedure • Sensors are replaced as per the job requirement following standard procedure • Solenoid valve is replaced as per the job requirement following standard procedure • Evaporator component is serviced as per the job requirement following standard procedure • Pressure switch is replaced as per the job requirement following standard procedure • Expansion valve is replaced as per the job requirement following standard procedure • Flushing is performed as per the job requirement following standard procedure • Vacuuming is performed as per the job requirement following standard procedure • Refrigerant is recharged as per the job requirement following standard procedure		
Contents	B2.01 Performing refrigerant recovery/pump down <i>Knowledge</i> • Purpose of refrigerant recovery • Effects of refrigerant on environment <i>Skills</i> • Using recovery machine • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player		

	• Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper hose connection B2.02 Servicing compressor component <i>Knowledge</i> • Symptoms, causes and remedies of compressor failure <i>Skills</i> • Using manifold gauge • Brazing skills • Using clamp meter • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B2.03 Servicing condensing unit <i>Knowledge</i> • Symptoms, causes and remedies of faulty condenser <i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Brazing skills • Analytical skills • Communication skills • Problem-solving skills
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	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas B2.04 Replacing sensors <i>Knowledge</i> • Functions of sensors • Types of sensors in VRV/VRF system <i>Skills</i> • Using multimeter • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to disconnect wires by unlocking the wire coupler B2.05 Replacing solenoid valve <i>Knowledge</i> • Function of solenoid valve • Types of solenoid valve • Operation of solenoid valve <i>Skills</i> • Using multimeter • Analytical skills
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	• Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B2.06 Servicing drain-out pump <i>Knowledge</i> • Function of drain out pump • Components of drain out system • Symptoms and causes of drain pump failure <i>Skills</i> • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to clean the drain-out pump at certain intervals to prevent buildup of algae, slime and debris B2.07 Servicing evaporator component <i>Knowledge</i> • Symptoms, causes and remedies of evaporator component failure <i>Skills</i> • Analytical skills • Communication skills
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	• Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B2.08 Replacing pressure switch <i>Knowledge</i> • Definition of pressure switch • Purpose of pressure switch • Types of pressure switch • Operation of pressure switch <i>Skills</i> • Using multimeter • Numeracy skills • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to wrap copper tube with wet towel while brazing B2.09 Replacing expansion valve <i>Knowledge</i> • Definition of expansion valve • Function of expansion valve • Types of expansion valves used in VRV/VRF Systems
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	• Operation of expansion valve • Factors affecting valve operation <i>Skills</i> • Brazing skills • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to wrap copper tube with wet towel while brazing B2.10 Performing flushing <i>Knowledge</i> • Purpose of flushing <i>Skills</i> • Using manifold gauge • Analytical skills • Communication skills • Problem-solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B2.11 Performing vacuuming <i>Knowledge</i> • Purpose of vacuuming
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	<i>Skills</i> • Using manifold gauge • Observation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B2.12 Recharging refrigerant <i>Knowledge</i> • Types of refrigerant cylinder and its uses • Effects of using contaminated refrigerant <i>Skills</i> • Using digital weighing scale • Using charging machine • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs

	• Audio-visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop Tools • Screwdriver set, plier, tester, wire stripper, crimping tool, flame deflector, capillary tube cutter, lighter, flaring tool set, wrench set and adjustable wrench Materials • Compressor relay, wires, insulation tape, thimble, overload protector, thermostat, timer, defrost heater, bi-metal, thermal fuse, internal fan motor, fan blade, capacitor, compressor, flux, filter drier, brazing rod, copper tube, dry nitrogen gas, capillary tube, condenser coil, evaporator, brazing torch, process tube, emery paper, soap solution, refrigerant, solenoid valve, wires, markin cloth, pen, notepad, sensors, pressure switch, expansion valve, acetylene gas and butane/propane gas Instruments • Clamp-on meter, weighing scale, micron gauge and manifold gauge set Equipment • VRV/VRF unit, recovery cylinder, recovery machine, brazing set, dry nitrogen gas cylinder set, refrigerant charging set and vacuum pump PPE • Working dress, safety goggles, safety gloves, safety boots, safety helmet and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice

	• Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carry out installation and servicing of VRF/VRV system		
Module Code	7127-L3-M2		
Learning Outcome 3	Troubleshoot faults of VRF/VRV system		
Duration	Theory: 2.5hours	Practical: 7hours	Total:9.5 hours
Assessment Criteria	- Electrical faults are diagnosed as per the job requirement following standard procedure - Mechanical faults are diagnosed as per the job requirement following standard procedure - Report is prepared as per the job requirement following standard procedure		
Contents	B3.01 Diagnosing electrical faults <i>Knowledge</i> - Symptoms, causes and remedies of electrical faults <i>Skills</i> - Using multimeter - Observation skills - Analytical skills - Communication skills - Problem-solving skills <i>Attitude, safety and environment concern</i> - Being time conscious - Being efficient in using resources - Being a team player - Having work ethics and integrity - Having patience - Proper handling of tools, materials, instrument and equipment - Ensuring to follow OHS rules and regulations - Ensuring appropriate use of PPE - Ensuring proper disposal of waste B3.02 Diagnosing mechanical faults <i>Knowledge</i> - Symptoms, causes and remedies of mechanical faults <i>Skills</i> - Using manifold gauge - Observation skills - Analytical skills - Communication skills - Problem-solving skills		

	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste B3.03 Preparing report <i>Knowledge</i> • Importance of documentation and record keeping <i>Skills</i> • Basic ICT skills • Documentation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools, materials, instrument and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop

	Tools • Screwdriver set, plier, ladder, calculator and tester Materials • Compressor relay, wires, insulation tape, thimble, overload protector, thermostat, timer, defrost heater, thermal fuse, internal fan motor, fan blade, capacitor, compressor, flux, filter drier, brazing rod, copper tube, dry nitrogen gas, capillary tube, condenser coil, evaporator, brazing torch, process tube, emery paper, soap solution, refrigerant, solenoid valve, wires, marking cloth, pen, notepad, sensors, pressure switch, expansion valve, acetylene gas and propane/butane gas. Instruments • Clamp-on meter/multi-meter, micron gauge, manifold gauge set and leak detector Equipment • VRF/VRV Unit, brazing set, computer and dry nitrogen gas cylinder set PPE • Safety gloves, safety boots, safety belt, safety helmet, safety goggles and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

MODULE 3: CARRYING OUT INSTALLATION AND SERVICING OF COMMERCIAL CHILLER/HEAT PUMP SYSTEM

MODULE INFORMATION

Occupation	HVAC Technician
Competency Area	Carry out installation and servicing of commercial chiller/Heat Pump system
Module Title	Carrying out installation and servicing of commercial chiller/Heat Pump system
Module Code	7127-L3-M3
Module Description	This module is structured to provide the learners with knowledge, skills and right attitude required to perform installation & servicing of chiller system and troubleshoot faults of chiller system
Nominal Duration	90.5 Hours
Certificate Level	BQF Certificate Level 3
Pre-requisite	Completed Module: 7127-L3-M2
Learning Outcome	1. Perform installation of chiller system 2. Perform servicing of chiller system 3. Troubleshoot faults of chiller system

Module Title	Carry out installation and servicing of commercial chiller/Heat Pump system		
Module Code	7127-L3-M3		
Learning Outcome 1	Perform installation of chiller/heat pump system		
Duration	Theory: 10.5 hours	Practical: 50 hours	Total: 60.5 hours
Assessment Criteria	• Site inspection is performed as per the job requirement following standard procedure • Estimation and costing are performed as per the job requirement following standard procedure • Installation layout is prepared as per job requirement following standard procedure • Outdoor unit is installed as per job requirement following standard procedure • Air Handling Unit (AHU) is installed as per job requirement following standard procedure • Fan Coil Unit (FCU) is as per job requirement following standard procedure • Air ducts are installed as per job requirement following standard procedure • Chilled Water Supply and Return pipe lines are installed as per job requirement following standard procedure • Water pump is installed as per job requirement following standard procedure • Leak test is performed as per the job requirement following standard procedure • Hydrostatic test is performed as per job requirement following standard procedure • Vacuuming is performed as per the job requirement following standard procedure • Refrigerant is charged as per the job requirement following standard procedure • Commissioning is performed as per the standard procedure		
Contents	C1.01 Performing site inspection Knowledge • Introduction to chiller/ Heat pump system • Types of chiller/heat pump system • Operation of chiller/heat pump system • Purpose of site selection Skills		

	• Observation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C1.02 Performing estimation and costing <i>Knowledge</i> • Definition of estimation and costing • Purpose of estimation and costing <i>Skills</i> • Basic ICT skills • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to get the price from genuine suppliers C1.03 Preparing installation layout <i>Knowledge</i> • Purpose of preparing installation layout <i>Skills</i> • Using drilling machine • Using spirit level
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	- Analytical skills - Communication skills <i>Attitude, safety and environment concern</i> - Being time conscious - Being efficient in using resources - Being a team player - Having work ethics and integrity - Having patience - Proper handling of tools and materials - Ensuring to follow OHS rules and regulations - Ensuring appropriate use of PPE - Ensuring proper disposal of waste C1.04 Installing outdoor unit <i>Knowledge</i> - Components of outdoor unit - Function of outdoor unit <i>Skills</i> - Using drilling machine - Using spirit level - Observation skills - Analytical skills - Communication skills <i>Attitude, safety and environment concern</i> - Being time conscious - Being efficient in using resources - Being a team player - Having work ethics and integrity - Having patience - Proper handling of tools and materials - Ensuring to follow OHS rules and regulations - Ensuring appropriate use of PPE - Ensuring proper disposal of waste C1.05 Installing Air Handling Unit (AHU) <i>Knowledge</i> - Introduction to AHU and Treated Fresh Air (TFA) Unit - Purpose of AHU - Components of AHU - Operation of AHU - Types of AHU - Application of AHU
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	<i>Skills</i> • Observation skills • Analytical skills • Communication skills • Planning skills • Problem solving skill <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C1.06 Installing Fan Coil Unit (FCU) <i>Knowledge</i> • Introduction to Fan coil unit • Components of fan coil unit • Types of fan coil unit • Operation of fan coil unit • Factors affecting fan coil unit selection <i>Skills</i> • Using drilling machine • Using clamp meter • Observation skills • Numeracy skills • Planning skills • Analytical skills • Communication skills • Problem solving skill <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE
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	• Ensuring proper disposal of waste C1.07 Installing air ducts <i>Knowledge</i> • Introduction to air duct • Types of sheet metal • Types of ducts and fittings • Clearances required in ducting <i>Skills</i> • Using drilling machine • Using lock forming machine • Using bending machine • Observation skills • Planning skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C1.08 Install Water Supply and Return pipe lines <i>Knowledge</i> • Function of water supply and return pipe lines • Components of water supply and return pipes and their functions <i>Skills</i> • Basic plumbing skills • Basic welding skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience
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	• Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper welding while joining the pipes C1.09 Installing water pump and water tank <i>Knowledge</i> • Function of water pump and insulated water tank • Types of water pump and tanks • Operation of water pump • Water pump head calculation <i>Skills</i> • Using phase sequence meter • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring to use phase sequence meter while connecting the power supply to water pump motor C1.10 Performing refrigerant leak test <i>Knowledge</i> • Purpose of leak test <i>Skills</i> • Using manifold gauge • Observation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources
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	• Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C1.11 Perform hydrostatic test <i>Knowledge</i> • Introduction to hydrostatic test • Purpose of hydrostatic test • Calculating test pressure <i>Skills</i> • Using test pump • Observation skills • Analytical skills • Communication skills • Planning skills • Numeracy skills • Problem solving skill <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring to apply specific pressure while performing hydrostatic testing C1.12 Performing vacuuming <i>Knowledge</i> • Purpose of vacuuming <i>Skills</i> • Using manifold gauge • Using vacuum pump • Using micron gauge • Analytical skills
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	• Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE C1.13 Charging refrigerant <i>Knowledge</i> • Methods of charging refrigerant <i>Skills</i> • Using weighing scale • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C1.14 Performing commissioning <i>Knowledge</i> • Purpose of commissioning <i>Skills</i> • Observation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player
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	• Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper monitoring of the system while commissioning
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop Tools • HVAC hand tool set, masonry hand tool set, screw driver set, plumbing hand tool set, hole saw, tin snips, hammer and calculators Materials • Marker, screws, pen, notepad, nuts & bolt, PVC dowels, silicon sealant, insulation sheet, fasteners, floor heating pipe, dry nitrogen gas, brazing torch, filler/brazing rod, process tube, soap solution, refrigerant, markin cloth, logbook, insulator, washers, pipe fittings (elbows, tees, reducers), ducts (galvanized steel, aluminium, PI or other suitable materials), insulation for ducts, duct connectors, flanges, duct tape, sealants, sheet metal, duct tapes, water pump, elbow joints, strainer, valves and teflon tape Instruments • Weighing scale, clamp-on meter, thermometer, air flow meter, manifold gauge set, measuring tape and pressure gauge Equipment • Air compressor, arc welding machine, cutting machine, pipe welding machine, brazing set, dry nitrogen gas cylinder set, ladder, chiller, heat pump, vacuum pump, AHU unit, drilling

	machine, computer, fan coil unit, lock forming machine, bending machine and test pump PPE • Safety gloves, safety boots, safety belt, safety helmet, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carry out installation and servicing of commercial chiller/ heat pump system		
Module Code	7127-L3-M3		
Learning Outcome 2	Perform servicing of chiller/heat pump system		
Duration	Theory: 4.5 hours	Practical: 17 hours	Total: 21.5 hours
Assessment Criteria	• Pump down/refrigerant recovery is performed as per the job requirement following standard procedure • Compressor component is serviced as per the job requirement following standard procedure • Condensing unit is serviced as per the job requirement following standard procedure • Water pump is serviced as per the job requirement following standard procedure • AHU is serviced as per the job requirement following standard procedure • FCU is serviced as per the job requirement following standard procedure • Flushing is performed as per the job requirement following standard procedure • Vacuuming is performed as per the job requirement following standard procedure • Refrigerant is recharged as per the job requirement following standard procedure		
Contents	C2.01 Performing pump down/ refrigerant recovery <i>Knowledge</i> • Purpose of refrigerant recovery • Effects of refrigerant on environment <i>Skills</i> • Using recovery machine • Using manifold gauge • Using weighing scale • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player		

	• Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.02 Servicing compressor component <i>Knowledge</i> • Symptoms, causes and remedies of faulty compressor component <i>Skills</i> • Analytical skills • Communication skills • Problem solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.03 Servicing condensing unit <i>Knowledge</i> • Symptoms, causes and remedies of faulty condensing unit <i>Skills</i> • Analytical skills • Communication skills • Problem solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE
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	• Ensuring proper disposal of waste C2.04 Servicing water pump <i>Knowledge</i> • Symptoms, causes and remedies of water pump failure <i>Skills</i> • Interpreting circuit diagram • Analytical skills • Communication skills • Problem solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.05 Servicing AHU <i>Knowledge</i> • Purpose of servicing AHU • Factors affecting performance of AHU • Interval of servicing AHU • Symptoms, causes and remedies of AHU failure <i>Skills</i> • Using clamp meter • Using tachometer • Using decibel meter • Observation skills • Analytical skills • Communication skills • Problem solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials
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	• Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.06 Servicing FCU <i>Knowledge</i> • Importance of servicing FCU • Interval of servicing FCU • Symptoms, causes and remedies of FCU failure <i>Skills</i> • Using clamp meter • Observation skills • Analytical skills • Communication skills • Problem solving skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.07 Performing flushing <i>Knowledge</i> • Purpose of flushing <i>Skills</i> • Using manifold gauge • Numeracy skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience
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	• Proper handling of tools, materials and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste • Ensuring proper handling of dry nitrogen gas C2.08 Performing vacuuming <i>Knowledge</i> • Purpose of vacuuming <i>Skills</i> • Using manifold gauge • Using micron gauge • Using vacuum pump • Observation skills • Communication skills • Analytical skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C2.09 Recharging refrigerant <i>Knowledge</i> • Method of charging refrigerant <i>Skills</i> • Using weighing scale • Using manifold gauge • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience
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	• Proper handling of tools, materials and equipment • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab with internet facilities • Workshop Tools • Screwdriver set, pliers, Allen key set, spanner set, adjustable wrench, pipe wrench, flame deflector, flaring tool, socket set, flashlight, inspection mirror, fin comb, brazing torch and high-pressure water hose Materials • Control panel, compressor, compressor relay, compressor overload, wires, thermal fuse, thimble, insulation tape, refrigerant, bearing, shaft, impeller, markin cloth, pen, notepad, condenser, copper tube, lighter, flux, filler rod, brazing rod, pump, lubricant, filter drier, gasket, dry nitrogen gas, emery paper, heat exchanger, process tube, capacitor, calculator and soap solution Instruments • Phase sequence meter, clamp-on meter, weighing scale, manifold gauge set, tachometer and decibel meter Equipment • Chiller controller, recovery cylinder, hydraulic press, recovery machine, dry nitrogen gas cylinder set, brazing set, condensing unit, chiller, heat pump, water pump, vacuum pump, computer, AHU, blower, vacuum cleaner, fan coil unit and ladder

	PPE • Safety gloves, safety belt, safety boots, safety goggles, safety helmet, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i> , the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i> , the following assessment methods: • Practical observation • Written test • Assignment

Module Title	Carry out installation and servicing of commercial chiller/heat pump system		
Module Code	7127-L3-M3		
Learning Outcome 3	Troubleshoot faults of chiller/heat pump system		
Duration	Theory: 2.5 hours	Practical: 6 hours	Total: 8.5 hours
Assessment Criteria	- Electrical faults are diagnosed as per the job requirement following standard procedure - Mechanical faults are diagnosed as per the job requirement following standard procedure - Report is prepared as per the job requirement following standard procedure		
Contents	C3.01 Diagnosing electrical faults <i>Knowledge</i> - Symptoms, causes and remedies of electrical faults <i>Skills</i> - Using multimeter - Interpreting circuit diagram - Observation skills - Analytical skills - Communication skills - Problem-solving skills <i>Attitude, safety and environment concern</i> - Being time conscious - Being efficient in using resources - Being a team player - Having work ethics and integrity - Having patience - Proper handling of tools and materials - Ensuring to follow OHS rules and regulations - Ensuring appropriate use of PPE - Ensuring proper disposal of waste C3.02 Diagnosing mechanical faults <i>Knowledge</i> - Symptoms, causes and remedies of mechanical faults <i>Skills</i> - Observation skills - Analytical skills - Communication skills - Problem-solving skills		

	<i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste C3.03 Preparing report <i>Knowledge</i> • Importance of documentation and record keeping <i>Skills</i> • Basic ICT skills • Documentation skills • Analytical skills • Communication skills <i>Attitude, safety and environment concern</i> • Being time conscious • Being efficient in using resources • Being a team player • Having work ethics and integrity • Having patience • Proper handling of tools and materials • Ensuring to follow OHS rules and regulations • Ensuring appropriate use of PPE • Ensuring proper disposal of waste
Learning Conditions	Learning materials • CBLM • Hand-outs • Audio-visuals • Reference books • Manuals Learning facilities and infrastructure • Classroom with adequate facilities • Library • IT lab

	• Workshop Tools • Screwdriver set, plier, tester, flaring tool set, swaging tool set, Allen key set, wrench set, brazing torch and plumbing tool set Materials • Relay, timer, gate valve, water pump, thermostat, PCB, fan motor, pressure switch, magnetic switch, thermo-fuse, dry nitrogen gas, filler rod, brazing rod, process tube and soap solution Equipment • Chiller, heat pump, FCU, AHU, brazing set, dry nitrogen gas cylinder set, computer, air compressor and welding machine Instruments • Clamp-on meter, leak detector, manifold gauge set and micron gauge PPE • Safety gloves, safety boots, safety belt, safety helmet, workshop dress and respiratory mask
Instructional Methodologies	The trainer shall use <i>inter alia</i>, the following instructional methods: • Lecture • Discussion • Guided practice • Group practice with project-based learning • Individual practice with problem-based learning
Method of Assessment	The trainer shall use <i>inter alia</i>, the following assessment methods: • Practical observation • Written test • Assignment

ON-THE-JOB TRAINING (OJT)

COURSE	Commercial Heating Ventilation and Air Conditioning BQF-C3
DESCRIPTION	The trainee will be attached with relevant industries for OJT program. During the OJT, the trainees will be exposed to real life working environment where they are expected to develop technical skills and learn positive working attitudes including life skills.
OBJECTIVE	After completion of OJT, learners will be able to • Develop critical thinking, creativity, collaboration and communication skills • Develop information, media and technology literacy • Adopt flexible and productive working attitude • Develop leadership skills • Apply initiatives • Develop social skills • Adopt OHS practices • Carry out installation and servicing of commercial refrigeration plant • Carry out installation and servicing of central air conditioning plant • Carry out installation and servicing of commercial heat pump/chiller
DURATION	280 Hours
CONDITIONS FOR OPERATION OF OJT	• The institute shall select relevant and reliable industry for OJT attachment • The trainee shall be attached in Heating Ventilation and Air Conditioning related activity for at least 70% of the total OJT duration • The industry shall maintain daily attendance of the trainee • The trainee shall maintain OJT logbook as per the OJT guideline • The trainee is required to follow company's rule • The collaborating industry shall provide working facilities • The industry shall assess performance of trainees • The industry shall provide feedback in the logbook

EVALUATION	The industry shall evaluate the trainees on the trainee's performance through observation and use of logbook. The evaluation shall be done on the following aspects of trainees: ➤ Critical thinking ➤ Creativity ➤ Collaboration ➤ Communication ➤ Information literacy ➤ Media literacy ➤ Conversant to up-to-date technology ➤ Flexibility ➤ Leadership ➤ Initiative ➤ Productivity ➤ Social skills ➤ Core skills
REPORT	The trainee shall submit comprehensive report on OJT to the Institute

What is Competency-Based Curriculum (CBC)

- ✓ A competency-based curriculum is a framework or guide for the subsequent detailed development of competencies, associated methodologies, training and assessment resources.
- ✓ The CBC specifies the outcomes which are consistent with the requirements of the workplace as agreed through the industry or community consultations.
- ✓ CBC can be developed immediately when competency standards exist.
- ✓ When competency standards do not exist, curriculum developers need to clearly define the learning outcomes to be attained. The standard of performance required must be appropriate to industry and occupational needs through the industry/enterprise or specified client group consultations.

The CBC materials are available in both printed and electronic copies.

ANNEXES

Annexure I: Time Distribution					
Commercial HVAC BQF-C3					
Module Title	Learning outcomes	Tasks	Theory (hours)	Practical (hours)	Total (hours)
A: Carrying out installation and servicing of commercial refrigeration system	A1: Perform installation of commercial refrigeration system	A1.00 Introductory knowledge	1	0	1
		A1.1 Perform site inspection	0.5	2	2.5
		A1.2 Perform estimation and costing	0.5	2	2.5
		A1.3 Prepare installation layout	1	2	3
		A1.4 Install indoor unit	1	15	16
		A1.5 Install outdoor unit	1	15	16
		A1.6 Perform leak test	0.5	1	1.5
		A1.7 Perform vacuuming	0.5	2	2.5
		A1.8 Charge refrigerant	1	2	3
		A1.9 Perform commissioning	1	2	3
	Sub total		8	43	51
	A2: Perform servicing of commercial refrigeration system	A2.1 Service refrigerator controller	1	2	3
		A2.2 Service defrost component	1	5	6
		A2.3 Replace compressor component	0.5	2	2.5
		A2.4 Replace condensing fan Unit	0.5	2	2.5
		A2.5 Service condenser	0.5	2	2.5
		A2.6 Replace expansion valve	1	3	4
		A2.7 Replace pressure switch	0.5	4	4.5
		A2.8 Service evaporator unit	0.5	2	2.5
		A2.9 Service commercial refrigerator door	1	4	5
		A2.10 Perform refrigerant recovery/pump down	0.5	1	1.5
		A2.11 Perform flushing	0.5	1	1.5
		A2.12 Perform vacuuming	0.5	1	1.5
		A2.13 Charge refrigerant	0.5	1	1.5
		A2.14 Perform testing of refrigeration system	0.5	2	2.5
	Sub total		9	32	41
	A3:	A3.1 Diagnose electrical faults	1	3	4

	Troubleshoot faults of commercial refrigeration system	A3.2 Diagnose mechanical faults	1	3	4
		A3.3 Prepare report	0.5	1	1.5
	Sub total		2.5	7	9.5
	Total Duration (A)		19.5	82	101.5
B: Carrying out installation and servicing of VRF/VRV system	B1: Perform installation of VRF/VRV system	B1.1 Perform site inspection	1	1	2
		B1.2 Perform estimation and costing	0.5	2	2.5
		B1.3 Prepare installation layout	0.5	3	3.5
		B1.4 Install indoor unit	0.5	21	21.5
		B1.5 Layout communication wires	0.5	3	3.5
		B1.6 Perform copper tube layout/drainage pipe layout	0.5	10	10.5
		B1.7 Install outdoor unit	0.5	4	4.5
		B1.8 Perform leak test	0.5	1	1.5
		B1.9 Perform vacuuming	0.5	1	1.5
		B1.10 Charge refrigerant	0.5	1	1.5
		B1.11 Perform commissioning	0.5	5	5.5
	Sub total		6	52	58
	B2: Perform servicing of VRF/VRV system	B2.1 Perform refrigerant recovery/pump down	0.5	1	1.5
		B2.2 Service compressor component	0.5	2	2.5
		B2.3 Service condensing unit	0.5	2	2.5
		B2.4 Replace sensors	0.5	2	2.5
		B2.5 Replace solenoid valve	1	2	3
		B2.6 Service drain-out pump	0.5	2	2.5
		B2.7 Service evaporator component	0.5	2	2.5
		B2.8 Replace pressure switch	0.5	2	2.5
		B2.9 Replace expansion valve	0.5	2	2.5
		B2.10 Perform flushing	0.5	1	1.5
		B2.11 Perform vacuuming	0.5	1	1.5
		B2.12 Recharge refrigerant	0.5	1	1.5
	Sub total		6.5	20	26.5
	B3: Troubleshoot faults	B3.1 Diagnose electrical faults	1	3	4
		B3.2 Diagnose mechanical faults	1	3	4

	VRF/VRV system	B3.4 Prepare report	0.5	1	1.5
	Sub total		2.5	7	9.5
	Total Duration (B)		15	79	94
C: Carrying out installation and servicing of commercial chiller system	C1: Perform installation of chiller system	C1.1 Perform site inspection	1	1	2
		C1.2 Perform estimation and costing	0.5	1	1.5
		C1.3 Prepare installation layout	1	2	3
		C1.4 Install outdoor unit	0.5	3	3.5
		C1.5 Install AHU	1	3	4
		C1.6 Install FCU	1	3	4
		C1.7 Install Air ducts	1	12	13
		C1.8 Install Chilled Water Supply and Return pipe lines	1	12	13
		C1.9 Install water pump	0.5	4	4.5
		C1.10 Perform refrigerant leak test	0.5	1	1.5
		C1.11 Perform hydrostatic test	1	5	6
		C1.12 Perform vacuuming	0.5	1	1.5
		C1.13 Charge refrigerant	0.5	1	1.5
		C1.14 Perform commissioning	0.5	1	1.5
	Sub total		10.5	50	60.5
	C2: Perform servicing of chiller system	C2.1 Perform pump down/refrigerant recovery	0.5	1	1.5
		C2.2 Service compressor component	0.5	2	2.5
		C2.3 Service condensing unit	0.5	2	2.5
		C2.4 Service water pump	0.5	3	3.5
		C2.5 Service AHU	0.5	3	3.5
		C2.6 Service FCU	0.5	3	3.5
		C2.7 Perform flushing	0.5	1	1.5
		C2.8 Perform vacuuming	0.5	1	1.5
		C2.9 Recharge refrigerant	0.5	1	1.5
	Sub total		4.5	17	21.5
	C3: Troubleshoot faults of chiller system	C3.1 Diagnose electrical faults	1	2	3
		C3.2 Diagnose mechanical faults	1	2	3
		C3.4 Prepare report	0.5	2	2.5
	Sub total		2.5	6	8.5

	Total Duration (C)	17.5	73	90.5
Total Duration (hours)		52	234	286

Annex II: Lesson Plan
Lesson Plan

Course Title:		NC Level:
Module Code:		Duration:
Module Title:		
Learning Outcome:		
Skill/Task/Topic:		
Terminal Performance Objective:		
<i>(Note: Write narrative statement extracted from TPO of Task Sheet)</i>		
Enabling Objectives (Related knowledge):		
<i>By the end of the lesson learners will be able to:</i>		
- i) - ii) - iii)		
What (Content/Activity)	Who (T/L)	How (Methods/Media)
Duration (Min.)	Questions	
<i>Introduction:</i>		
<i>Main body</i>		
<i>Conclusion</i>		
Projects/Problems:		

Instructional Resources Plan				
Skills/Task/Topic:				
No. of Trainees:				
Sl. No.:	Instructional materials/resources	Specifications	Qty.	Remarks
Prepared by :		Signature	Date:	
Revised by:		Signature	Date:	
Approved by:		Signature	Date:	

Task sheet

TS-1/4: Practical Plan

Course Title:		N C Level:
Module code:		Duration:
Module Title		
Learning outcome		
Skills/Task Title:		Task no:

Terminal Performance Objective:

Given:

Cue:

Who:

What:

Within:

How well:

-
-
-

Enabling Objectives (Related Skills):

By the end of a lesson, the learners will be able to:

- i)
- ii)
- iii)
- iv)

Activities	Who (T/L)	How (methods/ media)	Duration

Project/Assignment:

TS-2/4: Tool and Equipment required:							
Sl no.	Particulars	Specifications	Qty	Remarks			
Training Materials required:							
Sl no.	Particulars	Specifications	Qty.	Rate	Amount	Remarks	
TS-3/4:Performance Guide							
Skill/Task:					Date:		
Directions: Use the following performances criteria to rate the learner. Check YES/NO to indicate whether the learner performed each step as indicated or not?							
Sl. No:	Steps					Yes	No
Note: Critical steps: All * marked steps should be carried out very carefully. For a quality performance guide, all items should be checked "YES"							

TS-4/4: Instruction and Drawing

General Instructions for Trainees

- i)
- ii)
- iii)
- iv)

Drawing (if any)

Safety Precaution

- i)
- ii)
- iii)

Prepared by :

Signature

Date:

Revised By:

Signature

Date:

Approved by :

Signature

Date:

Annex IV: Course Plan
Institutes letter head and Logo

(Trade)YEAR PLAN- _____Semester_____ (Year)

Trade: NC Level:			Schedule																																								Total Hour s					
Module Code	Module Title	Learning Outcome	Feb.				March				April				May				June				July				Aug.				Sept				Oct.				Nov.									
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4										
OJT																																																
Assessment and Certification																																																

Prepared by:

Verified & Approved by:

Date:

Monthly/Weekly Plan

Month:

Trade:

Trainer:

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 01							
Week 02							
Week 03							
Week 04							
Week 05							

Developed by:

Approved by:

Date :



For more information please contact:

Technical Trainers Training and Resources (TTTRC), DWPSD

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