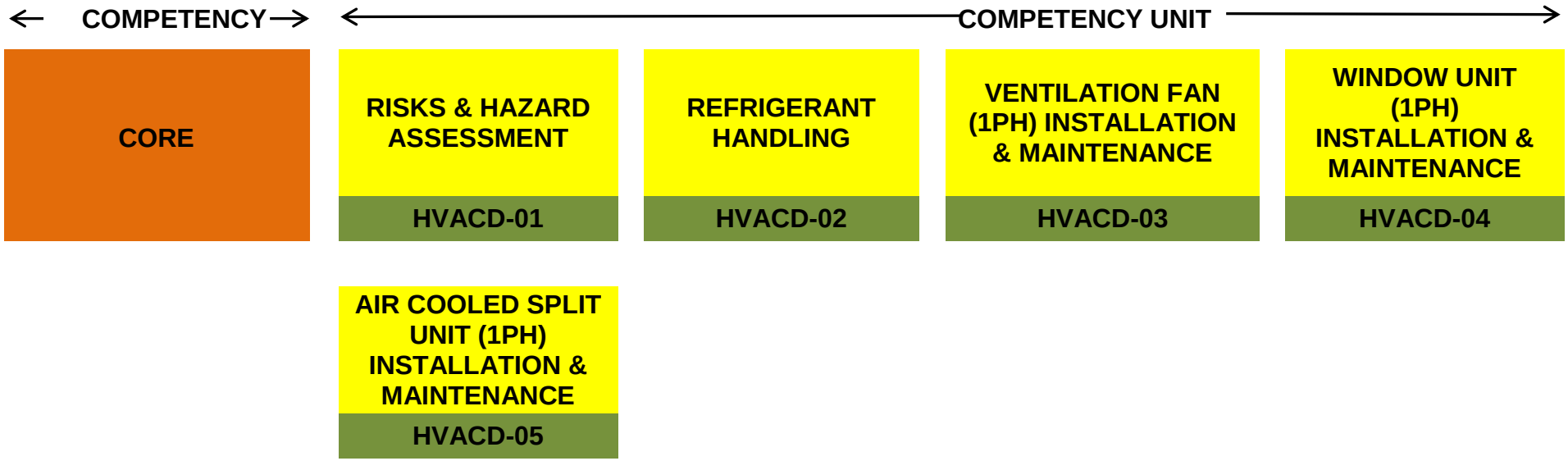
JOB PROFILE CHART (JPC)

SECTOR	**MECHANICAL ENGINEERING**		
SUB SECTOR	**HEATING VENTILATION AIR CONDITIONING (HVAC)**		
JOB AREA	**INSTALLATION, SERVICING, TROUBLESHOOTING & REPAIR (SINGLE PHASE AIR-CONDITIONING EQUIPMENT)**		
JOB LEVEL	**TWO (2)**	**JOB AREA CODE**	



COMPETENCY PROFILE (CP)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)**
Job Area	**INSTALLATION, SERVICING, TROUBLESHOOTING & REPAIR (SINGLE PHASE AIR-CONDITIONING EQUIPMENT)**
Level	**TWO (2)**

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
1. Risks & hazard assessment	HVACD-01	The installation, starting up and servicing of ventilating and air-conditioning equipment can be hazardous and requires specific knowledge and training.	1. Identify expected sequential steps for completion of work	1.1 Expected sequential steps for completion of work identified for the specific type of work
		Improperly installed, adjusted or altered equipment by an untrained person could result in	2. Carry out potential risk and hazard assessment	2.1 Potential hazard/risk determined
		serious injury, loss of limb or even death.The	3. Evaluate the risks and decide whether existing	3.1 Risk rating determined

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
		competency of risks & hazard assessment focus on identification of the safety precautions to eliminate/control hazards for each expected sequential steps for completion of work	precautions are adequate or more should be done 4. Carry out safety precautions required to eliminate/ control hazards planning	 4.1 Precaution required to eliminate risk identified 4.2 The specific service work is completed safely according to safety regulations

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
2. Refrigeration handling	HVACD-02	Refrigerant Handling focus on identification of system approaches to minimise refrigerant emissions to the atmosphere prior to opening an air conditioning system for servicing	1. Perform types of system approach identification	1.1 System approach correctly determined for the specific service
			2. Perform refrigerant recovery for the specific service	2.1 Method of refrigerant recovery correctly confirmed for the specific service
			3. Prepare refrigerant handling records	3.1 All refrigerant is recovered from the system and properly stored with zero emission to the atmosphere prior to opening the system for servicing

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
3. Ventilation fan (1ph) installation & maintenance	HVACD-03	Ventilation fan (1ph) can be standalone equipment or part of air conditioning system and its function is to move air for ventilation. The competency involved is focus on identification of the types of ventilation fan for installation, servicing, troubleshooting and preparation of service report.	1. Perform ventilation fan installation 2. Perform ventilation fan servicing	1.1 Type of ventilation fan determined for installation according to customer order 2.1 Ventilation fan installed correctly according to Manufacturer's IOM 2.2 The fan performs according to Manufacturer's IOM 2.3 The Customer acknowledgement of completion of fan installation

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
			3. Perform ventilation fan troubleshooting	3.1 Ventilation fan serviced properly according to Manufacturer's IOM 3.2 The fan perform according Manufacturer's IOM after the servicing 3.3 Customer acknowledgment of the completion servicing works
			4. Perform ventilation fan repairing	4.1 Ventilation fan troubleshooting was correct in rectification of the fault, and fan was

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
				restored to perform as per Manufacturer's IOM 4.2 Customer informed of status of troubleshooting progress , follow up action required or completion
4. Window unit (1ph) installation & maintenance	HVACD-04	Window unit (1ph) is stand alone air conditioning equipment and its function is to cool and dehumidify air for human comfort. The competency involved is focus on window unit air conditioner installation, servicing, troubleshooting and preparation of service	1. Perform window unit installation 2. Perform window unit servicing	1.1 Types of window unit identified for installation according to customer order 2.1 Window unit installed correctly according to Manufacturer's

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
		report.		IOM 2.2 The window unit performs according to Manufacturer's IOM 2.3 The Customer acknowledgement of completion of the window unit installation
			3. Perform window unit troubleshooting	3.1 Window unit serviced properly according to Manufacturer's IOM 3.2 The window unit perform according Manufacturer's IOM after the servicing

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
				3.3 Customer acknowledgment of the completion of the servicing works
			4. Perform window unit repairing	4.1 Window unit troubleshooting was correct in rectified of the fault, and window unit was restored to perform as per Manufacturer's IOM 4.2 Customer informed of status of troubleshooting progress , follow up action required or completion

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
5 Air cooled split unit (1ph) installation & maintenance	HVACD-05	Air Cooled Split Unit (1ph) is standalone air conditioning equipment and its function is to cool and dehumidify air for human comfort. The competency involved is focus on window unit air conditioner installation, servicing, troubleshooting and preparation of service report	1. Perform air cooled split unit installation	1.1 Split unit installed correctly according to manufacturer's IOM 1.2 The split unit performed according to manufacturer's IOM 1.3 The customer acknowledgement of completion of the split unit installation
			2. Perform air cooled split unit servicing	2.1 The split unit serviced properly according to Manufacturer's IOM 2.2 The split unit

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
				perform according Manufacturer's IOM after the servicing 2.3 Customer acknowledgment of the completion of the servicing works
			3. Perform air cooled split unit troubleshooting	3.1 Split unit troubleshooting was correct in rectification of the fault, and window unit was restored to perform as per manufacturer's IOM 3.2 Customer informed of status of

CU Title	CU Code	CU Descriptor	CU Work Activities	Performance Criteria
				troubleshooting progress , follow up action required or completion
			4. Perform air cooled split unit repair	4.1 Split unit repaired and perform according to Manufacturer's IOM 4.2 Customer's acknowledgement of repair work performed

CURRICULUM of COMPETENCY UNIT (CoCU)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)**						
Job Area	**SERVICING, TROUBLESHOOTING & REPAIR (THREE PHASE AIRCONDITIONING EQUIPMENT)**						
Competency Unit Title	**RISK & HAZARD ASSESSMENT**						
Competency Unit Descriptor	Risk and hazard assessment can be defined as a process involve several procedures that need to be done in order to ensure safe working condition namely identifying hazard, assessing the risk and controlling the risk.						
Competency Unit ID	**01**	**Level**	2	**Training Duration**	145 hours	**Credit Hours**	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
1. Identify expected sequential steps for completion of work	i. Equipment Installation, Operation, Maintenance (IOM) service procedure ii. Standard operation procedure			12 Hours	Lecture	• Safety precautions identified to eliminate/ control • Risk definition confirmed • Risk matrix table generated
		i. Identify equipment Installation, Operation, Maintenance (IOM) service procedure	i. Follow safety policy ii. Initiates ideas for safety improvement	23 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		ii. Identify steps for specific service on the particular equipment prior to commencement of work iii. Confirm steps for specific installation, maintenance and service of the particular equipment				
2. Carry out potential risk and hazard assessment	i. Past incidents/ accidents information ii. Information about equipment (e.g. plant, operating instructions) iii. Material Safety Data Sheets iv. Methods of Identifying hazard and hazardous situations v. Accident Investigation			14 hours	Lecture	• Risk assessment methodology determined according to hazardous policy • Risk definition determined • Incident/ accident repetition probability assessed • Current activities at work areas/ work sites

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	vi. Necessary actions to eliminate or control the risk vii. Other risk factors should also be as they may contribute to the risk such as • Work premises • Working environment including their layout and condition • Capability, skill, experience and age of people ordinarily undertaking work • Systems of work being used • Range of reasonably foreseeable conditions					determined • Safety precautions to eliminate/ control identified

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		i. Examine past incidents/ accidents information ii. Examine current activities at Work areas/ work sites iii. Review Material Safety Data Sheets iv. Predict hazardous event could take place v. Identify factors that may be contributing to the risk vi. Review health and safety information that is reasonably available from an authoritative source and is relevant to the particular hazard vii. Evaluate the likelihood of an	i. Follow safety policy ii. Understand the concerns of others iii. Participates in safety training iv. Initiates ideas for safety improvement	24 hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		injury occurring and the likely severity of an injury or illness that may occur viii. Identify the actions necessary to eliminate or control the risk ix. Identify records that it is necessary to keep to ensure that the risks are eliminate or controlled x. Identify other risk factors may contribute to the risk				

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
3. Evaluate the risks and decide whether existing precautions are adequate or more should be done	i. Simplified numerical risk estimation technique ii. Risk matrix			14 hours	Lecture	• Risk assessment methodology determined • Risk definition determined
	.	i. Rate potential risk and hazard ii. Estimate how likely each hazard could cause harm iii. Assess existing precautions iv. Determine whether the company need to do more to reduce the risk	i. Follow safety policy ii. Understand the concerns of others iii. Participates in safety training iv. Work with others in a professional manner	24 hours	Demonstration	
4. Carry out safety precautions required to eliminate/ control hazards planning	i. Expected sequential steps for completion of work ii. Potential risk/hazard iii. Safety policy iv. Safety audit			10 hours	Lecture	• Documentation of safety training • Reporting on accident, near miss and first aid case • Documentation

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	v. Fleet safety vi. Hearing Protection vii. Fall protection viii. Log Out Tag out ix. Hazard Communication x. Respiratory Protection xi. Confined Space xii. Documentation on accident, near miss and first aid case xiii. Documentation of workers safety training xiv. Initiates ideas for safety improvement xv. Crisis Management					on accident, near miss and first aid case • Generate company crisis management plan • Regular checking in done to ensure that the control measures stay in place and clear responsibilities
		i. Perform expected sequential steps for completion of work ii. Determine	i. Follow safety policy ii. Wear safety PPE when specified iii. Report	24 hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		potential of risk rating for each sequential step of work iii. Perform safety precautions to eliminate/control hazard/risk for each sequential step of work iv. Monitor safety precautions implementation	accidents, near miss and first aid case iv. Participates in safety training			

Employability Skills

Core Abilities	Social Skills
01.01 Identify and gather information 02.01 Interpret and follow manuals, instructions and SOP's 02.04 Prepare brief reports and checklist using standard form 03.05 Demonstrate safety skills 05.04 Delegate responsibilities and/or authority 05.03 Allocate and record usage of financial and physical resources 06.02 Comply with and follow chain of command 06.01 Understand system 06.03 Identify and highlight problems	1. Communication skills 2. Conceptual skills 3. Interpersonal skills 4. Learning skills 5. Leadership skills 6. Multitasking 7. Self-discipline 8. Teamwork 9. Self –reliance 10. Meticulous 11. Diligence 12. Compliance

Tools, Equipment and Materials (TEM)

ITEMS	RATIO (TEM : Trainees)
Basic HVAC (Heating Ventilation Air Conditioning) hand tools	1:20
Risk matrix	1:20
Material Safety Data Sheets	1:20
Computer	1:20

References:

1. A.B. Constantinos, B. Francesco, H. Sten Olaf & etl.,(2000). *Report No 22: Risk Assessment In Relation To Indoor Air Quality*. Luxembourg; European Communities. ISBN: 92-828-9284-0
2. Committee on Risk Appraisal in the Development of Facilities Design Criteria , National Research Council , & et.al. , 1991. *Uses of Risk Analysis to Achieve Balanced Safety in Building Design and Operations (Studies in Management of Building Technology: A Series) [Paperback]*. National Academies Press. ISBN:0309046807
3. A. Eitan & K. Abraham, (1988). *Engineering Risk and Hazard Assessment, Vol. 1.* 1 ed., CRC Press. ISBN:0849346568

CURRICULUM of COMPETENCY UNIT (CoCU)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)- DOMESTIC**						
Job Area	**INSTALLATION, SERVICING, TROUBLESHOOTING& REPAIR (SINGLE PHASE AIRCONDITIONING EQUIPMENT)**						
Competency Unit Title	**REFRIGERANT HANDLING**						
Competency Unit Descriptor	Refrigerant handling focus on identification of system approach to minimise refrigerant emissions to the atmosphere prior to opening an air conditioning system for servicing						
Competency Unit ID		**Level**	2	**Training Duration**	111 Hours	**Credit Hours**	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
1. Perform types of system approach identification	i. Types of system approach for the specific service - Isolation - Pump down - Recovery ii. Types of refrigeration circuit iii. Opening up a refrigeration system without venting of refrigerant to the atmosphere iv. Approach to reduce emissions of refrigerant			12 Hours	Lecture	• Types of refrigeration circuit determined according to system approach • Knowledge on company environment policy • Core information on refrigerants

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	v. Refrigerant recovery options					
		i. Diagnose refrigeration problems ii. Determine refrigeration work required iii. Isolate part of refrigeration system for repair iv. Carry out system pump down v. Select refrigerant recovery options	i. Safety minded ii. Observes safety precautions iii. Wear safety PPE when specified iv. Follow safety & environmental policy	23 Hours	Demonstration	
2. Perform refrigerant recovery for the specific service	i. The 3 R's of service practices ii. Operation of Recovery/recycle Machine for liquid or vapour recovery iii. Operation of			14 Hours	Lecture	• Refrigerant system shortage level recognised • Suitable refrigerant recovery method applied

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	Reclaim Machine iv. methods of refrigerant recovery • Recovery • Recycle • Reclaim v. Operation of recovery/ recycle/ reclaim machine vi. Core Information of types of refrigerant – R22, R404a, R134a, R407C, R410a, R123 vii. Refrigerant safety viii. Impact of refrigerant emission to the atmosphere ix. Ozone depletion x. Global Warming xi. Core information on refrigeration oil xii. Regulations that governs refrigerant recovery					• Leakage found and fixed • Refrigerant system evacuated and dehydrated properly to ensure that non condensable gases and moisture are removed
		i. Determine condition of refrigeration system ii. Determine number of	i. Observant to the Impact of refrigerant emission to the atmosphere	24 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	xiii. Recovery machine safety xiv. High pressure refrigerant recovery xv. Low pressure refrigerant recovery xvi. Proper handling and disposal for refrigerants and oil xvii. Internal and external storage xviii. Storage capacity of recovery cylinder xix. Recovery cylinder safety	storage cylinder required for refrigerant recovery iii. Determine types of refrigerant iv. Confirm refrigerant recovery method to apply v. Operate recovery/ recycle / reclaim machine vi. Ensurerefrigerant system functionality vii. Remove service gauges without releasing refrigerant to atmosphere viii. Apply refrigerant recovery procedure ix. Comply with	ii. Observant to Ozone depletion iii. Observant to Global Warming iv. Comply with Regulations that governs refrigerant recovery v. Observant to recovery cylinder capacity			

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		Regulations that governs refrigerant recovery				
3. Prepare refrigerant handling records	i. Details of all maintenance work and repairs such as • Quantities, kind of refrigerant charged (new, re-used or recycled) on each occasion, and quantities transferred from the system on each occasion • analysis results of re-used refrigerant • Source of re-used refrigerant • Changes and replacements of components of the system • Results of periodic routine tests • Significant			14 hours	Lecture	• Refrigerant handling recorded with all details • Changes and replacements of components of the system identified • Produce refrigerant handling records
		i. Determine refrigerant handling records requirement ii. Determine quantities and kind of refrigerant charged iii. Determine	i. Observes safety precautions ii. Wear safety PPE when specified iii. Follow safety & environmental	24 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	periods of non-use.	analysis results of re-used refrigerant iv. Determine source of re-used refrigerant v. Determine changes and replacements of components of the system vi. Determine results of periodic routine tests vii. Determine significant periods of non-use viii. Produce refrigerant handling records	policy			

Employability Skills

Core Abilities	Social Skills
01.01 Identify and gather information 02.01 Interpret and follow manuals, instructions and SOP's 02.04 Prepare brief reports and checklist using standard form 03.05 Demonstrate safety skills 05.04 Delegate responsibilities and/or authority 05.03 Allocate and record usage of financial and physical resources 06.02 Comply with and follow chain of command 06.01 Understand system 06.03 Identify and highlight problems	1. Communication skills 2. Conceptual skills 3. Interpersonal skills 4. Learning skills 5. Leadership skills 6. Multitasking 7. Self-discipline 8. Teamwork 9. Self –reliance 10. Meticulous 11. Diligence 12. Compliance

Tools, Equipment and Materials (TEM)

ITEMS	RATIO (TEM : Trainees)
DOE regulation on ozone depleting substances	1:1
Refrigerant Recovery Manuel	1:1
ASHRAE Standard – safety code for mechanical refrigeration	1:1
Clean Air Act	1:1
Refrigerant MSDS	1:1
Recovery Machine, fittings, hoses, pressure and vacuum gauge	1:1
Reclaim machine, fittings, hoses, pressure and vacuum gauge	1: 2
Basic hand tools –spanners, ratchets, screw drivers, etc	1: 2

CURRICULUM of COMPETENCY UNIT (CoCU)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)- DOMESTIC**						
Job Area	**INSTALLATION, SERVICING, TROUBLESHOOTING& REPAIR (SINGLE PHASE AIRCONDITIONING EQUIPMENT)**						
Competency Unit Title	**VENTILATION FAN (1PH) INSTALLATION & MAINTENANCE**						
Competency Unit Descriptor	Ventilation fan (1ph) is a component of the air conditioning system and its function is to move air for ventilation or distribution of air. The competency involved is focus on identification of the types of ventilation fan for installation, servicing, troubleshooting and preparation of service report.						
Competency Unit ID		**Level**	2	**Training Duration**	141 Hours	**Credit Hours**	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
1. Perform ventilation fan installation	i. Types of ventilation fan • Propeller fan • Tube axial fan • Inline centrifugal ii. Types of single phase motor starting • Shaded pole • Permanent split capacitor • Split phase			14 Hours	Lecture	• Types of ventilation fan correctly identified according to checklist • Types of single phase motor starting selected according to wiring diagram / name plate • Cutting tools selected correctly according to

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	• Capacitor start iii. Cutting hole sizes iv. Types of building material such as • Brick • Wood • Metal v. Appropriate cutting tools such as • Jigsaw • Hacking vi. Fan disassemble technique vii. Single phase wiring works	i. Differentiate types of ventilation fan ii. Identify types of single phase motor starting iii. Determine opening size / location for installing fan iv. Select appropriate cutting tools based construction material to cut the intended opening v. Select fastening screws for mounting fan vi. Install fan into opening /location vii. route Electrical cabling to power source viii. Test run ventilation fan ix. Verify fan performance x. Generate report on completion of fan	i. Adhere to electrical safety handling procedure ii. Observe Fall protection safety	24 Hours	Demonstration	building material • Fan assembly fit according to hole size • Fan disassemble according to instruction manual • Electrical cabling route properly according electrical specification • Fan is operating in proper functional order

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		installation				
2 Perform ventilation fan servicing	i. Types of ventilation fan components such as • Damper • Blower • Bearing • Mounting ii. Types of cleaning chemical such as • Soap • Detergent iii. Types of lubricant such as • Oil • Grease iv. Types of cleaning rags such as • Cotton v. Types of brush such as • Paint brush • Condenser brush			10 hours	Lecture	• Ventilation fan components identified according to maintenance requirement • Types of cleaning chemical selected based on material of components • Types of lubricant selected according to manufacturer requirement • Types of cleaning rags selected according to component assembly • Types of brush selected according to component assembly
		i. Obtain ventilation fan service requirement checklist ii. Determine ventilation fan components iii. Select suitable	i. Resourceful of electrical safety handling procedure ii. Fall protection safety iii. Hazard communication	25 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		rags for cleaning the specific component iv. Select suitable cleaning chemical v. Clean ventilation fan blade vi. Clean ventilation fan housing vii. Determine types of lubricant viii. Carry out ventilation fan bearing greasing ix. Check ventilation fan electrical connection for tightness x. Check ventilation fan performance xi. Prepare ventilation fan service completion report	on chemicals			

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
3. Perform ventilation fan troubleshooting	i. Types of faults • Unable to run • Noisy • Vibration • Motor overheated • Jammed • Short circuit • Insufficient air flow ii. Faults report iii. Manufacturers installation, operation and maintenance manual iv. Operating principle v. Wiring diagram			10 Hours	Lecture	• Fault sources determined based on customer complaints • Fan installed, operated, and maintained according to manufacturers installation, operation and maintenance manual • Review Manufacturer's troubleshooting guide • Identify defective parts replacement required for fault rectification • Understand operating principle • Understand wiring diagram schematics
		i. Study manufacturer troubleshooting guide ii. Identify types of faults iii. Rectify the fault immediately iv. Prepare faults report	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection safety	20 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
4. Perform ventilation fan repairing	i. Types of worn out / defective parts • Motor • Fan blade • Capacitor • Bearing • Damper • Electrical completeness (Cabling & switches) ii. Type of electrical test instrument • Multi meter • Ampere meter iii. Identification of defective part required iv. Method of replacement with appropriate tools • Disassembly • Re-assembly			14 Hours	Lecture	• Types of worn out / defective parts identified according to faults rectification • Electrical instrument testing to confirm faults • Correct parts identified for the faults • Method and part replacement are correct for faults rectification • Report is accurate and complete for fault rectification

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		i. Determine ventilation fan scope of repair required ii. Select appropriate electrical instrument for testing iii. Confirm required parts specification iv. Check required parts specification availability v. Apply appropriate method for parts replacement work vi. Test ventilation fan functionality after repairing vii. Prepare ventilation fan repairing record for reference	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection safety	24 Hours	Demonstration	

Employability Skills

Core Abilities	Social Skills
01.01 Identify and gather information 02.01 Interpret and follow manuals, instructions and SOP's 02.04 Prepare brief reports and checklist using standard form 03.05 Demonstrate safety skills 05.04 Delegate responsibilities and/or authority 05.03 Allocate and record usage of financial and physical resources 06.02 Comply with and follow chain of command 06.01 Understand system 06.03 Identify and highlight problems	1. Communication skills 2. Conceptual skills 3. Interpersonal skills 4. Learning skills 5. Leadership skills 6. Multitasking 7. Self-discipline 8. Teamwork 9. Self –reliance 10. Meticulous 11. Diligence 12. Compliance

Tools, Equipment and Materials (TEM)

ITEMS	RATIO (TEM : Trainees)
Basic HVAC (Heating Ventilation Air Conditioning) hand tools	1:20
Support tools	1:20
Electrical tools	1:20
Special tools	1:20

References:

1. Paul Roe Jordan(1955), Ventilation manual for sheet metal contractors;: A treatise on the type of ventilation which sheet metal contractors are called upon to plan and install,
2. Gerald R Bodman(1995), Ventilation fans: Types and sizes (NebGuide)
3. David P Shelton(1982), Ventilation fans: Types and sizes (NebGuide)
4. James E. Brumbaugh(Aug 6, 2004), Audel HVAC Fundamentals, Air Conditioning, Heat Pumps and Distribution Systems
5. George Edward McElroy(1923), Air-measured methods for experimental work on fan-pipe installations (Report of investigations / United States Department of the Interior, Bureau of Mines)
6. Charles L. Hubbard(Apr 27, 2009), The Ventilation Hand Book: The Principles and Practice of Ventilation as Applied to Furnace Heating Ducts, Flues and Dampers For Gravity Heating Fans and ... With the Method of Ventilating Ships
7. Paul Roe Jordan(1955),Ventilation manual for sheet metal contractors;: A treatise on the type of ventilation which sheet metal contractors are called upon to plan and install,

CURRICULUM of COMPETENCY UNIT (CoCU)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)- DOMESTIC**						
Job Area	**INSTALLATION, SERVICING, TROUBLESHOOTING& REPAIR (SINGLE PHASE AIRCONDITIONING EQUIPMENT)**						
Competency Unit Title	**WINDOW UNIT (1PH) INSTALLATION & MAINTENANCE**						
Competency Unit Descriptor	Window unit (1ph) is a component of the air conditioning system and its function is to cool and dehumidify air for human comfort. The competency involved is focus on capacity of the window unit for installation, servicing, troubleshooting and preparation of service report.						
Competency Unit ID		**Level**	2	**Training Duration**	148 hours	**Credit Hours**	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
1. Perform window unit installation	i. Window unit manufacturer installation, operation and maintenance manual ii. Window unit capacity • 1.0HP ~ 9000 Btu / Hr • 1.5HP ~ 13000 Btu / Hr • 2.0HP ~ 18000 Btu /			14 Hours	Lecture	• Capacity of window unit correctly installed according to customer order • Electrical circuit has sufficient current carrying capacity according to full load amps requirement • Determine height and width of window / opening

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	Hr iii. Full load Amps iv. Size of power cables v. Name plate vi. Building structure vii. Window unit manufacturer installation, operation and maintenance manual viii. Height and width of window / opening according to manufacturer specification ix. Method of air conditioner mechanism removal from casing x. Method to fix empty case in the window /					is correct for the unit case • Air conditioner mechanism removed from casing properly according to manufacturer instruction • Empty casing securely mounted in the window / opening • Unit is sloping outside according to manufacturer instruction • Fasten the cabinet to the opening / window frame with screw run through the hole • Air conditioner mechanism installed correctly according to manufacturer
		i. Identify window unit capacity ii. Determine full load Amps iii. Determine size of power cables iv. Interpret information of name plate v. Assess building structure strength vi. Recognise window unit manufacturer installation manual vii. Determine height and width of window / opening is	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Meticulous in cutting safety handling v. Careful in removing air conditioner mechanism from casing to avoid any damage	24 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	opening xi. Method to fix air conditioner mechanism into casing xii. Method to fix insulation or weather stripping xiii. Basic electrical work xiv. Building structure xv. Height and width of window / opening according to manufacturer specification	correct for the unit case viii. Select appropriate cutting tools based construction material to cut the intended opening ix. Position empty case in the window / opening x. Place the empty casing to sloped outside (equal to a half bubble on a tool ~ water level) xi. Fasten the empty casing to the opening / window frame with screw run				instruction • No gaps on the perimeter of casing • Unit in proper functional order • Method of air conditioner mechanism removal from casing • Method to fix empty case in the window / opening • Method to fix air conditioner mechanism into casing • Method to fix insulation or weather stripping

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		through the hole xii. Raise and sit the air conditioner mechanism into casing xiii. Seal all gaps with insulation or weather stripping xiv. Plug on and power up the air conditioner xv. Test window unit functionality and performance xvi. Confirm window unit installation completion xvii. Prepare report on completion of window unit installation				

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
2. Perform window unit servicing	i. Window unit components • Air filter • Drain pan & drain pipe • Cooling & condenser coil • Compressor • Unit cabinet • Condenser fan • Blower ii. Types of cleaning chemical such as • Soap • Detergent iii. Types of lubricant such as • Oil • Grease iv. Cleaning rags v. Types of brush • Paint brush • Condenser brush			13 Hours	Lecture	• Window unit components identified according to maintenance requirement • Types of cleaning chemical selected based on material of components • Types of lubricant selected according to manufacturer requirement • Types of cleaning rags selected according to component assembly • Types of brush selected according to component assembly

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		i. Obtain window unit service requirement checklist ii. Determine window unit components to service iii. Select suitable cleaning chemical for window unit servicing iv. Select appropriate lubricant for window unit servicing v. Select suitable cleaning rags for window unit servicing vi. Select suitable brush for window unit servicing vii. Clean window unit filter	i. Follow electrical safety handling procedure ii. Adhere to Fall protection safety iii. Careful in chemical handling	25 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		viii. Clean window unit cooling coil ix. Clean window unit fan blade x. Clean window unit fan housing xi. Grease window unit oil fan bearing xii. Clean window unit air grilles xiii. Check window unit electrical connection for tightness xiv. Clean window unit condenser coil xv. Clean/clear window unit condensate drain pipe of any blockage xvi. Test window unit functionality and performance				

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		xvii. Prepare window unit servicing completion report				
3. Perform window unit troubleshooting	i. Window unit manufacturers troubleshooting manual ii. Types of window unit faults • Unable to run • Noisy / Humming • Vibration • Motor or compressor overheated • Motor or compressor jammed • Short circuit • Insufficient air flow • Room temperature not cool			12 Hours	Lecture	• Fault sources determined based on customer complaints • Fan installed, operated, and maintained according to manufacturers installation, operation and maintenance manual

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	• Leaked • Remote control not function • Overflow of Condensation water • Short cycling of compressor or motor • Condensation on the damper iii. Faults report iv. Operating principle v. Wiring diagram					
		i. Recognise window unit manufacturers troubleshooting manual ii. Recognise window unit operating principle vi. Recognise window unit wiring diagram	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection	24 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		schematics iii. Determine types of window unit faults iv. Determine window unit defective parts replacement required for fault rectification v. Rectify window unit fault vi. Prepare fault report if window unit fault cannot be rectified immediately	safety			
4. Perform window unit repairing	i. Condenser coil performance evaluation ii. Evaporator coil evaluation iii. Functionality of blower fan / motor iv. Functionality of condenser fan / motor			12 Hours	Lecture	• Types of worn out / defective parts identified according to faults rectification • Electrical tools and HVAC tools testing to confirm faults • Correct parts identified for the

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	v. Functionality of Metering Device vi. Functionality of Compressor vii. Functionality of Thermostat (Room Temperature Controller) viii. Functionality of I.C board ix. Functionality of Remote controller x. Functionality of Electrical Starter xi. Functionality of Capacitor xii. Functionality of Air Damper xiii. Functionality of Refrigeration Circuit xiv. Electrical completeness (Cabling & switches) xv. Type of electrical					faults • Method and part replacement are correct for faults rectification

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	test tools and ACMV tools • Multi meter • Ampere meter • Meggar meter • Pressure Gauge Manifold xvi. Method of replacement with appropriate tools • Disassembly • Re-assembly					
		i. Determine types of worn out / defective parts ii. Select appropriate electrical tools and HVAC tools for testing iii. Determine required parts to replace specification iv. Apply appropriate	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection safety	24 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		method for parts replacement work v. Test window unit functionality and performance after part replacement vi. Confirm window unit functionality and performance after part replacement vii. Prepare window unit repairing record for reference				

Employability Skills

Core Abilities	**Social Skills**
01.01 Identify and gather information 02.01 Interpret and follow manuals, instructions and SOP's 02.04 Prepare brief reports and checklist using standard form 03.05 Demonstrate safety skills 05.04 Delegate responsibilities and/or authority 05.03 Allocate and record usage of financial and physical resources 06.02 Comply with and follow chain of command 06.01 Understand system 06.03 Identify and highlight problems	1. Communication skills 2. Conceptual skills 3. Interpersonal skills 4. Learning skills 5. Leadership skills 6. Multitasking 7. Self-discipline 8. Teamwork 9. Self –reliance 10. Meticulous 11. Diligence 12. Compliance

Tools, Equipment and Materials (TEM)

ITEMS	RATIO (TEM : Trainees)
Window unit air conditioner (Various Capacity and Size)	1:20
Basic HVAC (Heating Ventilation Air Conditioning) hand tools	1:20
Support tools	1:20
Electrical tools	1:20
Special tools	1:20

References:

1. Home Heating & Air Conditioning Systemsby James L. Kittle(Apr 1, 1990)
2. Troubleshooting and Servicing Modern Air Conditioning and Refrigeration Systemsby John Tomczyk(Sep 1, 1995)
3. Air Conditioning and Refrigeration Repairby Roger A. Fischer and Ken Chernoff(Aug 1, 1988)
4. Servicing comfort cooling systems: fundamentals of installation, troubleshooting, and repairby William Walton Woodroof(1983)

CURRICULUM of COMPETENCY UNIT (CoCU)

Sub Sector	**HEATING VENTILATION AIR CONDITIONING (HVAC)- DOMESTIC**						
Job Area	**INSTALLATION, SERVICING, TROUBLESHOOTING& REPAIR (SINGLE PHASE AIRCONDITIONING EQUIPMENT)**						
Competency Unit Title	**AIR COOLED SPLIT UNIT (1PH) INSTALLATION & MAINTENANCE**						
Competency Unit Descriptor	Air Cooled Split unit (1ph) is a component of the air conditioning system and its function is to cool and dehumidify air for human comfort. The competency involved is focus on the capacity and types of the air cooled split for installation, servicing, troubleshooting and preparation of service report.						
Competency Unit ID		**Level**	2	**Training Duration**	148 hours	**Credit Hours**	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
1. Perform air cooled split unit (Indoor) installation	i. Air cooled split unit capacity • 1.0HP ~ 9000 Btu / Hr • 1.5HP ~ 13000 Btu / Hr • 2.0HP ~ 18000 Btu / Hr • 2.5HP ~ 24000 Btu / Hr • 3.0HP ~ 28000 Btu / Hr ii. Full load Amps iii. Size of power cables			12 Hours	Lecture	• Capacity of air cooled split unit correctly installed according to customer order • Electrical circuit has sufficient current carrying capacity according to full load amps requirement • The indoor unit is install in the best location for air distribution

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	iv. Air cooled split unit (Indoor) installation technique v. Location for installing indoor and outdoor unit vi. Mounting brackets					• The indoor unit is securely mounted • The unit operate quietly • The refrigerant piping has no condensation • Condensate water can flow smoothly thru the drain pipe • The outdoor unit has proper heat rejection • All piping are securely and neatly routed
		i. Determine air cooled split unit capacity ii. Determine location for installing indoor and outdoor unit iii. Select appropriate tools for cutting opening for refrigerant piping iv. Fabricate mounting brackets for outdoor unit v. Select	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection safety	26 Hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		fastening screws for mounting indoor unit vi. Execute indoor and outdoor installation vii. Connect refrigerant piping viii. Purge/evacuate refrigerant piping ix. Perform leak test connections and fittings x. Route electrical cable from power source to indoor and outdoor unit				
2. Perform air cooled split unit servicing	i. Air cooled split unit components •Washable air filter •Refrigerant pipe			12 hours	Lecture	• Air cooled split unit components identified according to maintenance requirement

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	•thermal insulation •Drain pan •Drain pipe •Cooling coil (indoor unit) & condenser coil (outdoor unit) •Compressor •Indoor Unit mounting / outdoor unit bracket •Condenser fan •Blower fan ii. Types of cleaning chemical such as • Soap • Detergent iii. Types of lubricant such as • Oil • Grease iv. Cleaning rags v. Types of brush such as • Paint brush					• Types of cleaning chemical selected based on material of components • Types of lubricant selected according to manufacturer requirement • Types of cleaning rags selected according to component assembly • Types of brush selected according to component assembly

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	• Condenser brush					
		i. Obtain service requirement checklist ii. Determine air cooled split unit components to service iii. Select suitable cleaning chemical for split unit components service iv. Select suitable lubricant for split unit components service v. Select suitable cleaning rags for split unit components service vi. Select suitable	i. Resourceful of electrical safety handling procedure ii. Fall protection safety iii. Hazard communication on chemicals	26 hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		brush for split unit components service vii. Clean split unit filter viii. Clean split unit cooling coil ix. Clean split unit fan blade x. Clean split unit fan housing xi. Carry out split unit fan bearing oiling xii. Clean split unit air grilles xiii. Check split unit electrical connection for tightness xiv. Clean split unit condenser coil xv. Clean/clear split unit condensate drain pipe to avoid blockage				

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		xvi. Test split unit functionality and performance xvii. Prepare split unit service completion report				
3. Perform air cooled split unit troubleshooting	i. Types of faults • Unable to run • Noisy / motor or compressor humming • Vibration • Compressor ,condenser fan or blower motor overheated • Compressor, condenser fan or blower motor jammed • Short circuit • Insufficient air flow • Room temperature			12 hours	Lecture	• Fault sources determined based on customer complaints • Fan installed, operated, and maintained according to manufacturers installation, operation and maintenance manual

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	not cool • Leaked • Remote control not function • Overflow of Condensation water • Short cycling of compressor, condenser fan or blower motor • Condensation on the damper ii. Faults report iii. Manufacturers installation, operation and maintenance manual iv. Operating principle v. Wiring diagram					
		i. Recognise split unit manufacturer's troubleshooting guide ii. Recognise split	i. Observe safety precaution ii. Wear safety clothing or PPE where	25 hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		unit operating principle iii. Recognise split unit wiring diagram schematics iv. Determine types of split unit faults v. Determine split unit defective parts replacement required for fault rectification vi. Rectify split unit fault vii. Prepare fault report if split unit fault cannot be rectified immediately	required iii. Resourceful of electrical safety – lock out / tag out (LOTO) iv. Fall protection safety i. Meticulous in paying attention to details ii. Thorough in diagnosis of fault and troubleshooting			
4. Perform air cooled split unit repairing	i. Types of worn out / defective parts such as • Condenser fan Motor			10 hours	Lecture	• Types of worn out / defective parts identified according to faults rectification

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	• Blower fan motor • Compressor • Room temperature controller • I.C board • Remote controller • Electrical Starter • Fan blade • Capacitor • Bearing • Damper • Capillary tube • Liquid strainer/ drier • Dirty of condenser /evaporator fin coil • Electrical completeness (Cabling & switches) • Thermal insulation					• Electrical tools and ACMV tools testing to confirm faults • Correct parts identified for the faults • Method and part replacement are correct for faults rectification

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
	ii. Type of electrical test instrument and ACMV tools such as • Multi meter • Ampere meter • Megger meter • Manifold pressure gauge iii. Identification of defective part required iv. Method of replacement with appropriate tools • Disassembly • Re-assembly					
		i. Determine types of split unit worn out / defective parts ii. Select appropriate electrical tools and ACMV tools for testing iii. Confirm	i. Observe safety precaution ii. Wear safety clothing or PPE where required iii. Resourceful of electrical safety – lock out / tag out	25 hours	Demonstration	

Work Activities	Related Knowledge	Applied Skills	Attitude / Safety / Environmental	Training Hours	Delivery Mode	Assessment Criteria
		required parts specification iv. Check required parts specification availability v. Apply appropriate method for split unit parts replacement work vi. Test split unit functionality after repairing vii. Prepare split unit repairing record for reference	(LOTO) iv. Fall protection safety iii. Meticulous in paying attention to details iv. Thorough in diagnosis of fault and troubleshooting			

Employability Skills

Core Abilities	Social Skills
01.01 Identify and gather information 02.01 Interpret and follow manuals, instructions and SOP's 02.04 Prepare brief reports and checklist using standard form 03.05 Demonstrate safety skills 05.04 Delegate responsibilities and/or authority 05.03 Allocate and record usage of financial and physical resources 06.02 Comply with and follow chain of command 06.01 Understand system 06.03 Identify and highlight problems	1. Communication skills 2. Conceptual skills 3. Interpersonal skills 4. Learning skills 5. Leadership skills 6. Multitasking 7. Self-discipline 8. Teamwork 9. Self –reliance 10. Meticulous 11. Diligence 12. Compliance

Tools, Equipment and Materials (TEM)

ITEMS	RATIO (TEM : Trainees)
Basic HVAC (Heating Ventilation Air Conditioning) hand tools	1 : 20
Support tools	1 : 20
Electrical tools	1 : 20
Special tools	1 : 20

References:

1. John S. Page (1978), Estimator's Man-Hour Manual on Heating, Air Conditioning, Ventilating, and Plumbing, Second Edition (Man-Hour Manuals)
2. Dick Wirz (2009), **Commercial Refrigeration: For Air Conditioning Technicians**
3. Richard Jazwin (August 1, 2001), **Troubleshooting and Servicing HVAC&R Electrical Systems**
4. R S Means Company(Paperback - Sep 2001), Square Foot & Assemblies Estimating Methods (Means Square Foot & Assemblies Estimating)