10.1.0 PLANT MAINTENANCE AND SAFETY

10.1.1 Introduction

This module unit is intended to equip the trainee with knowledge, skills, attitudes and competences that will enable him/her install and maintain building services equipment, internal combustion engines and power transmission systems.

10.1.2 General Objectives

By the end of the module unit, the trainee should be able to:

a) demonstrate knowledge and understanding of occupational safety and health issues
b) apply acquired skills of building services equipment, internal combustion engines and power transmission systems in industry
c) install building services equipment, internal combustion engines and power transmission systems
d) maintain building services equipment, internal combustion engines and power transmission systems

10.1.3 Module Unit Summary and Time Allocation

Code	Sub Module Unit	Content	Time (Hrs)		
			Theory	Practice	Total
10.1.01	Legislation	• Main provisions • Duties and responsibilities	8	0	8
10.1.02	Safety and Health	• Safety factors • Health factors	4	0	4
10.1.03	First Aid	• Types of injuries • Actions in case of injuries • Types of dressings • Methods of handling injured persons. • Life saver equipments • Contents in a first aid box	4	2	6

10.1.04	Fire Fighting	• Definition of fire • Classes of fire • Types of fire fighting agents • Methods of fire detection • Methods of fire prevention • Fire fighting appliances and their colour coding • Safety signs	6	8	14
10.1.05	Maintenance Management	• Functions of plant maintenance department • Classifications of plant maintenance • Types of plant maintenance • Procedure for setting a maintenance programme	6	0	6
10.1.06	Bearings	• Classification of bearings • Types of bearings	6	4	10
10.1.07	Lubrication	• Definition of the term lubrication • Lubricating systems	6	9	15
10.1.08	Mechanical Power Transmission	• Types of power transmission systems • Constructional features of various types of power transmission systems • Principles of operation of various power transmission systems	10	20	30
10.1.09	Electric Motors	• Definition of term “electric motor”	6	8	14

		• Classification of electric motors • Types of electric motors • Cooling systems of electric motors			
10.1.10	Pumps	• Classification of various types of pumps • Constructional features of various types of pumps • Principles of operation of various types of pumps	10	15	25
10.1.11	Internal Combustion Engines	• Classification of internal combustion engines • Constructional features of internal combustion engines • Operating principles of internal combustion engines • Internal Combustion engine systems	10	16	26
10.1.12	Pipework	• Classification of pipes • Pipe materials • Description of pipe fittings and valves	6	8	14
10.1.13	Cold Water Supply	• Systems of cold water supply • Unboosted systems in highrise cold water supply • Description of the various components used in cold water supply	6	6	12
10.1.14	Hot Water Supply	• Various types of hot water systems • Heat energy sources	6	6	12

		• Heating appliances • Hot water system layouts • Components used in hot water systems			
10.1.15	Lifts and Escalators	• Classification of types of lifts • Working principle of lift pumps • Features of a lift • Classification of escalators • Working principle of escalators • Features of escalators	8	6	14
Total Time			102	108	210

10.1.01 LEGISLATION

Theory

10.1.01T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;

a) state the main provisions of Occupational Safety and Health Act (OSHA)
b) explain the general duties and responsibilities with respect to safety, health and welfare

10.1.01C Competence
The trainee should have the ability to practice the provisions of the act with respect to safety, health and welfare

Content

10.1.01T1 Main provisions
i) health provision
ii) welfare provisions
iii) safety provisions

10.1.01T2 Duties and responsibilities
i) health and safety officers
ii) employers
iii) employees
iv) third party

Suggested Teaching/Learning Resources
- OSHA
- Safety charts
- Safety posters

10.1.02 SAFETY AND HEALTH

Theory

10.1.02T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;

a) explain safety factors in working places
b) explain health factors in working environment

10.1.02C Competence
The trainee should have the ability to:
i) maintain safety in work places
ii) identify potential health hazards

Content

10.1.02T1 Safety factors
i) lifting techniques
ii) hand tools
iii) powered hand tools and equipments
iv) plant, machinery and equipments

v) personal protective clothing

10.1.02T2 Health factors
i) cleanliness
ii) overcrowding
iii) ventilation
iv) lighting
v) drainage

Practice

10.1.02P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) demonstrate safe lifting techniques
b) use hand tools effectively
c) use powered hand tools effectively
d) maintain safe working conditions in work places

Content
10.1.02P1 Lifting techniques
i) planning ahead before lifting
ii) lifting close to the body with legs apart
iii) bending knees with the back straight
iv) tightening the stomach muscles
v) lift with your legs
10.1.02P2 Hand tools
10.1.02P3 Powered hand tools
10.1.02P4 Maintenance of work places
i) cleaning of gangways
ii) adequate lighting
iii) proper ventilations
iv) proper arrangements of materials and machines
v) evacuation procedure manuals

Suggested Teaching/Learning Resources
- OSHA
- Safety charts
- Safety posters

10.1.03 FIRST AID

Theory

10.1.03T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) describe types of injuries
b) explain types of actions to be taken incase of injuries
c) describe types of dressings
d) explain methods of handling injured persons
e) describe life saver equipments
f) describe the contents in a first-aid box

10.1.03C Competence

The trainee should have the ability to:

i) identify cases of first aid
ii) handle injured persons
iii) observe precautions while undertaking first aid

Content

10.1.03T1 Types of injuries

i) burns
ii) electric shock
iii) inhale of toxic gases
iv) swallowing of poisonous substances
v) broken limbs
vi) explosion effects
vii) choking effects
viii) bruises and cuts
ix) drowning

10.1.03T2 Actions in case of injuries

i) evacuations
ii) alarm
iii) mouth to mouth resuscitation
iv) dressing of wounds
v) removing of chocking obstacles
vi) reporting of injuries

10.1.03T3 Types of dressings

i) bandages
ii) gauze
iii) slings

10.1.03T4 Methods of handling injured persons

i) lifting of injured persons
ii) resting of injured persons
iii) transporting injured persons

10.1.03T5 Life saver equipments

i) oxygen cylinders
ii) oxygen masks
iii) blankets
iv) stretchers
v) slings
vi) automated external defiabrillator

10.1.03T6 Contents in a first aid box

i) bandages
ii) gauze
iii) spirit
iv) hand gloves

Practice

10.1.03P *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;

a) identify cases of first aid
b) handle injured persons
c) observe precautions while undertaking first aid

Content

10.1.03P1 Identification of first aid cases
- i) burns
- ii) electric shock
- iii) bruises and cuts
- iv) broken limbs
- v) drowning
- vi) chocking
- vii) inhalation of toxic gas

10.1.03P2 Handling of injured persons
- i) lifting
- ii) resting
- iii) transporting

10.1.03P3 Precaution measures in first aid
- i) precaution against infectious diseases
- ii) precaution against contagious diseases

Suggested Teaching/Learning Resources
- First aid box
- Dressing materials
- Stretchers
- Alarm systems
- Oxygen masks
- Oxygen cylinders
- Slings
- Blankets
- Gloves
- Dummys

10.1.04 FIRE FIGHTING

Theory

10.1.04T *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;
- a) define fire
- b) explain the classes of fire
- c) explain the types of fire fighting agents
- d) explain methods of fire detection
- e) explain methods of fire prevention
- f) describe the appliances used in fire fighting and their colour coding
- g) describe various fire safety signs

10.1.04C Competence

The trainee should have the ability to:
- i) identify different types of fire fighting appliances
- ii) distinguish different classes of fire
- iii) maintain fire fighting equipment

Content

10.1.04T1 Definition of fire

10.1.04T2 Classes of fire
- i) A
- ii) B
- iii) C

iv) D
v) E

10.1.04T3 Types of fire-extinguishing agents
i) foam
ii) water
iii) sand
iv) blankets
v) carbon dioxide
vi) dry powder

10.1.04T4 Methods of fire detection
i) smoke detector
ii) heat detector
iii) light detector
iv) visualization

10.1.04T5 Methods of fire prevention
i) good housekeeping
ii) workshop layout
iii) proper maintenance of equipment, machines and wiring

10.1.04T6 Fire fighting appliances and their colour coding
i) portable fire extinguisher
- carbon dioxide
- dry powder
- foam
- water

ii) fixed fire extinguisher
- dry powder
- wet riser
- dry riser
- sprinklers
- dry/wet riser
- hydrants

10.1.04T7 Safety signs
i) hazard diamond
ii) emergency signs

Practice

10.1.04P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) install fire fighting equipment
b) commission fire fighting equipment
c) extinguish fires
d) maintain fire fighting equipment

Content
10.1.04P1 Install fire fighting equipment
10.1.04P2 Commission fire fighting equipment
10.1.04P3 Extinguish different classes of fire
10.1.04P4 Maintain fire fighting equipment

Suggested Teaching/Learning Resources
- OSHA
- Fire fighters safety manual
- Fire fighting appliances

10.1.05 MAINTENANCE MANAGEMENT

Theory

10.1.05T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;

a) explain the functions of plant maintenance department
b) explain the classes of plant maintenance
c) explain the forms of plant maintenance
d) explain the procedure of setting up a maintenance programme

10.1.05C Competence
The trainee should have the ability to have the ability to carry out and prepare a maintenance programme

Content

10.1.05T1 Functions of a plant maintenance department

10.1.05T2 Classification of plant maintenance
i) planned
ii) unplanned
iii) centralized
iv) decentralized

10.1.05T3 Forms of plant maintenance
i) planned
- preventive
- shut down
- predictive

ii) unplanned
- breakdown
- emergency
- corrective/ repair

10.1.05T4 Procedure for setting up a maintenance programme

Suggested Teaching/Learning Resources
- Maintenance structures charts
- Typical maintenance programme

10.1.06 BEARINGS

Theory

10.1.06T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;

a) classify bearings
b) describe the various types of bearings
c) explain the use of different types of bearings

10.1.06C Competence

The trainee should have the ability to:

i) select a bearing for a particular application
ii) mount bearings
iii) troubleshoot bearings
iv) dismount bearings

Content

10.1.06T1 Classification of bearings
i) according to construction features
ii) according to loading
iii) according to lubrication method

10.1.06T2 Types of bearings
i) roller
ii) ball
iii) plain
iv) needle
v) plummer block

10.1.06T3 Use of different types of bearings
- load bearing
- centralizing
- alignment

Practice

10.1.06P *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;
a) identify various types of bearings
b) mount bearings
c) trouble-shoot bearings
d) dismount bearings
e) service bearings

Content

10.1.06P1 Identification of various types of bearings
10.1.06P2 Mounting bearings
10.1.06P3 Troubleshooting bearings
i) wear
ii) misalignment
iii) vibration
iv) heating
v) seals
vi) lubrication
10.1.06P4 Dismounting bearings
i) pullers
ii) heaters
iii) soft hammer
iv) hydraulic press
10.1.06P5 Servicing bearings
i) cleaning
ii) alignment
iii) greasing

Suggested Teaching/Learning Resources
- Various bearings
- Mandrel
- Hand pump
- Hydraulic press
- Shafts
- Housings
- Pullers
- Soft hammer
- Grease

- Dial test indicator (DTI)
- Induction heating machine

10.1.07 LUBRICATION

Theory

10.1.07T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) define the term lubrication
b) explain the various classification of lubricants
c) explain the various properties of lubricants
d) explain the various lubrication additives
e) describe various lubrication systems

10.1.07C Competence
The trainee should have the ability to:
i) identify lubricants
ii) lubricate equipment and machines
iii) maintain lubrication systems

Content
10.1.07T1 Definition of the term lubrication
10.1.07T2 Classification of lubricats
10.1.07T3 Properties of lubricants
i) viscosity
ii) viscosity index
iii) flash point
iv) fire point
v) pour point
10.1.07T4 Types of lubricant additives
i) anti-rust
ii) anti-oxidant
iii) viscosity index improvers
10.1.07T5 Lubricating systems
i) drop feed
ii) collar
iii) chain
iv) ring
v) wick-feed
vi) oil
vii) splash
viii) gravity
ix) force feed
x) centralized

Practice

10.1.07P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) identify lubricants
b) lubricate equipment and machines
c) maintain lubrication systems

Content

10.1.07P1 Identification of lubricants

10.1.07P2 Lubrication of equipment and machines

10.1.07P3 Maintenance of lubrication systems

Suggested Teaching/Learning Resources

- Lubricants
- Lubricating devices
- Plant lubrication components

10.1.08 MECHANICAL POWER TRANSMISSION

Theory

10.1.08T *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;

a) classify various types of power transmission elements
b) describe the constructional features of various types of power transmission elements
c) explain the principles of operation of various types of power transmission elements

10.1.08C Competence

The trainee should have the ability to:

i) install different types of power transmission elements
ii) trouble shoot different types of power transmission elements
iii) maintain different types of power transmission elements

Content

10.1.08T1 Types of power transmission elements

i) couplings
   - flexible
   - rigid
   - fluid
   - friction
ii) gears
   - spur
   - bevel
   - worm and wheel
   - rack and pinion
   - helical
   - epicyclic
   - hypoid
iii) chains
   - singlex
   - duplex
   - multiplate

- friction

iv) belts
- flat
- vee
- timing

10.1.08T3 Construction features of various types of power transmissions elements
i) flanges
ii) ball
iii) flexible disc
iv) cube
v) pulleys
vi) float disc
vii) chain
viii) belts
ix) gears
x) friction disc
xi) friction clutches

10.1.08T2 Principles of operation of various power transmission elements

Practice

10.1.08P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) identify different types of power transmission elements
b) select a particular power transmission elements for a particular application
c) install different types of power transmission elements
d) trouble-shoot different types of power transmission elements
e) maintain different types of power transmission elements

Content

10.1.08P1 Identification of different types of power transmission elements
i) couplings
ii) gears
iii) chains
iv) clutches
v) belts

10.1.08P2 Selection of a particular power transmission system
i) cost
ii) alignment requirement
iii) accessibility
iv) power transmitted
v) maintainability

10.1.08P3 Installation of different types of power transmission systems
i) alignment
- vertical
- horizontal

ii) misalignment
- angular
- parallel
- end float

iii) belt tension
iv) joining belts
-bonding
-clips

10.1.08P4 Troubleshooting of different types of power transmission systems
i) worn out belts
ii) belt slippage
iii) cracked belts
iv) wear of sprockets
v) wear of gear teeth
vi) wear of plate
vii) creep

10.1.08P5 Maintenance of various power transmission systems
i) lubrication
ii) removal of dirt and dust
iii) dressing of belts
iv) chain tension
v) sleave wear
vi) belt guards

Suggested Teaching/Learning Resources
- Couplings
- Gears
- Belts
- Clutches
- Chains
- Power transmission system

10.1.09 ELECTRIC MOTORS

Theory

10.1.09T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) define the term electric motor
b) classify the various types of motors
c) explain the various types of electric motors
d) explain the various cooling systems of electric motor

10.1.09C Competence
The trainee should have the ability to:
i) identify different types of electric motors
ii) maintain electric motors
iii) provide guarding to electric motors

Content

10.1.09T1 Definition of term "electric motor"

10.1.09T2 Classification of electric motors
i) weather proof
ii) dust proof

10.1.09T3 Types of electric motors
i) A/C
ii) D/C

10.1.09T4 Cooling systems of electric motors
- i) air cooled
- ii) water cooled
- iii) oil cooled

Practice

10.1.09P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) identify different types of electric motors
- b) install electric motors
- c) maintain electric motors
- d) install motor guards

Content

10.1.09P1 Identification of electric motors

10.1.09P2 Installation of electric motors
- i) mounting
- ii) alignment
- iii) testing

10.1.09P3 Maintenance of electric motors
- i) cleaning
- ii) checking of bearings
- iii) lubrication

10.1.09P4 Guarding of electric motors
- i) safety guards

Suggested Teaching/Learning Resources
- Motors
- Starters and overloads protection equipments
- Manuals and drawings
- Motor
- Measuring equipments tool kit
- gauges

10.1.10 PUMPS

Theory

10.1.10T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) classify the various types of pumps
- b) describe the constructional features of various types of pumps
- c) explain the working principles of various types of pumps

10.1.10C Competence
The trainee should have the ability to:
- i) install different types of pumps

ii) trouble-shoot different pumps
iii) maintain different types of pumps

Content

10.1.10T1 Classification of various types of pumps
i) Positive displacement
- reciprocating
- swash plate
- lobe
- gear
- screw
- vane

ii) Non-positive
- centrifugal

10.1.10T2 Construction features of various types of pumps
i) impeller
ii) volute casing
iii) piston
iv) gear
v) lobes
vi) seals
vii) stuffing box

10.1.10T3 Principles of operation of various pumps
i) reciprocating
- piston
- diaphragm
- swash plate

ii) rotary
- gear
- centrifugal
- screw
- lobe
- sliding vane

Practice

10.1.10P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) identify different types of pumps
a) install different types of pumps
b) start and stop different types of pumps
c) troubleshoot different types of pumps
d) dismantle, repair and assemble different types of pumps

Content

10.1.10P1 Identification of different types of pumps
i) piston
ii) diaphragm
iii) swash plate
iv) gear
v) centrifugal
vi) screw
vii) lobe
viii) sliding vane

10.1.10P2 Installation of different types of pumps
i) foundation
ii) alignment
iii) priming
iv) testing

10.1.10P3 Troubleshooting different types of pumps
- i) pump does not start
- ii) pump fails to discharge
- iii) pump discharges then stops
- iv) pump not up to capacity
- v) noisy or vibrating pump
- vi) pump takes too much power
- vii) cavitation
- viii) leakage
- ix) overheating
- x) airlock

10.1.10P4 Dismantling, repairing and assembling different types of pumps
- i) isolation of pump
- ii) dismantling
- iii) cleaning
- iv) inspection
- v) repair/replace
- vi) assembling
- vii) testing

Suggested Teaching/Learning Resources
- Tool kits
- Pumps
- Cleaning agents
- Manuals/drawings
- Repair kit
- Testing rig

10.1.11 INTERNAL COMBUSTION ENGINES

Theory

10.1.11T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) classify internal combustion engines
- b) describe the constructional features of internal combustion engines
- c) explain the operating principles of internal combustion engines
- d) describe various internal combustion engine systems

10.1.11C Competence
The trainee should have the ability to:
- i) install internal combustion engines
- ii) troubleshoot internal combustion engines
- iii) maintain internal combustion engines

Content

10.1.11T1 Classification of internal combustion engines
- i) spark ignition and compression ignition engines
- ii) two stroke and four stroke engines
- iii) inline and v-engines
- iv) air cooled and water cooled engines

10.1.11T2 Constructional of features of internal combustion engines
- i) engine block
- ii) cylinder head
- iii) crankshaft
- iv) piston/con-rod assembly
- v) pumps
- vi) sump
- vii) camshaft
- viii) flywheel

10.1.11T3 Operating principles of internal combustion engines
- i) two stroke
- ii) four stroke

10.1.11T4 Internal combustion engine systems
- i) fuel
- ii) cooling
- iii) starting
- iv) charging
- v) braking
- vi) lubricating

Practice

10.1.11P *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to;
- a) identify different types of internal combustion engines
- b) install internal combustion engines
- c) trouble-shoot different types of internal combustion engines
- d) dismantle, repair and assemble different types of internal combustion engines

Content

10.1.11P1 Identification of different types of internal combustion engines
- i) spark ignition
- ii) compression ignition
- iii) two – stroke
- iv) four – stroke
- v) water cooled
- vi) air cooled
- vii) inline engine
- viii) v-engine

10.1.11P2 Installation of internal combustion engines
- i) foundation
- ii) mounting
- iii) alignment

10.1.11P3 Trouble-shoot of internal combustion engines
- i) overheating
- ii) low power
- iii) excessive noise
- iv) smoky exhaust
- v) excessive vibration
- vi) engine not starting

10.1.11P4 Dismantling, repairing and assembling of internal combustion engines
- i) isolation of the engine
- ii) drainage
- iii) dismantling
- iv) cleaning
- v) inspection
- vi) repair/replace
- vii) assembling
- viii) testing

Suggested Teaching/Learning Resources
- Tool kits
- Internal combustion engines
- Tuning devices (timing light and stroboscope)
- Cleaning agents
- Repair kits
- Manuals/drawings

10.1.12 PIPEWORK

Theory

10.1.12T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) classify pipes for various applications
- b) explain materials used in pipe manufacture
- c) describe pipe fittings and valves
- d) interpret pipework sketches and drawings
- e) state common pipe lagging materials
- f) state different types pipe mountings

10.1.12C Competence
The trainee should have the ability to:
- i) install pipes for different applications
- ii) maintain pipework systems
- iii) test pipe systems

Content

10.1.12T1 Classification of pipes
- i) steam
- ii) water
- iii) pneumatic
- iv) hydraulic

v) refrigerant

10.1.12T2 Pipe work materials
- i) copper
- ii) galvanized iron
- iii) polyvinyl chloride (PVC)
- iv) unplastisised
- v) cast iron
- vi) concrete
- vii) galvanized steel
- viii) asbestos
- ix) ductile iron
- x) bamboo
- xi) poly-propylene random (PPR)

10.1.12T3 Description of pipe fittings and valves
- i) pipe fittings
  - sockets
  - bushes
  - nipples
  - unions
  - elbows
  - bends
  - tees
  - crosses
- ii) valves
  - gate
  - pressure reducing
  - check
  - globe
  - butterfly
  - non return
  - foot
  - pressure relief
  - drain
  - air

Practice

10.1.12P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) identify various classes of pipes for various applications
- b) join pipes using various methods
- c) bend pipes using different methods
- d) install various types of pipes
- e) install various types of appliances
- f) test piping systems

Content

10.1.12P1 Identification of various class of pipes for various application
- i) high pressure
- ii) low pressure

10.1.12P2 Pipe joining methods
- i) welding
  - arc
  - gas
- ii) lock ring
- iii) threading
- iv) flaring
- v) cement
  - solvent
  - mortar

10.1.12P3 Pipe bending methods
- i) manual
  - cold
  - heat

ii) machine

10.1.12P4 Installation of pipes
- i) brackets
- ii) u-bolts
- iii) trunkings
- iv) rawl bolts

10.1.12P5 Installation of appliances
- i) hot water storage cylinders
- ii) feed cistern
- iii) hose reels
- iv) refrigerator

10.1.12P6 Testing of piping systems
- i) pressure
- ii) leakage

Suggested Teaching/Learning Resources
- Text books
- Journals
- Bending machines
- Tools and equipment
- Pipes
- Fittings

10.1.13 COLD WATER SUPPLY

Theory

10.1.13T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) explain the various systems of cold water supply
b) describe unboosted systems in high rise building cold water supply
c) describe boosted systems in high rise building cold water supply
d) describe various components used in cold water supply

10.1.13C Competence
The trainee should have the ability to:
- i) install a cold water supply system
- ii) troubleshoot cold water supply system
- iii) maintain a cold water supply system

Content

10.1.13T1 Systems of cold water supply
- i) direct system
- ii) indirect system
- iii) combined

10.1.13T2 Unboosted system in high rise cold water supply

10.1.13T3 Boosted systems in high rise cold water supply
- i) pneumatic vessel

10.1.13T4 Description of the various components used in cold water supply
- i) bib cock
- ii) non-return valves

iii) gate valves
iv) stop valves
v) cistern
vi) tank
vii) pipes
viii) pneumatic vessel
ix) vent pipes

Practice

10.1.13P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) install cold water supply system
b) trouble-shoot cold water supply system
c) maintain cold water supply systems

Content
10.1.13P1 Installation of cold water supply systems
10.1.13P2 Troubleshoot cold water supply systems
i) leakages
ii) air locks
iii) water hammer
10.1.13P3 Maintenance of cold water supply system
Suggested Teaching/Learning Resources
i) various fittings
ii) pipes
iii) tanks
iv) cisterns
v) pumps
vi) pneumatic vessel
vii) compressors

10.1.14 HOT WATER SUPPLY

Theory

10.1.14T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) describe the various types of hot water systems
b) explain the heat energy sources
c) describe various heating appliances
d) describe various types of hot water system layouts
e) describe various components used in hot water supply systems

10.1.14C Competence
The trainee should have the ability to:
i) install a hot water system
ii) troubleshoot a hot water supply system
iii) maintain a hot water supply system

Content

10.1.14T1 Various types of hot water systems
- i) indirect
- ii) direct
- iii) combined

10.1.14T2 Heat energy sources
- i) solid fuel
- ii) electricity
- iii) oil
- iv) gas
- v) solar

10.1.14T3 Heating appliances
- i) boilers
- ii) electric heaters
- iii) gas heaters
- iv) solar

10.1.14T4 Hot water system layouts
- i) centralized
- ii) zoned

10.1.14T5 Components of hot water systems
- i) calorifiers
- ii) tanks
- iii) pipes
- iv) valves
- v) bath
- vi) vent pipe
- vii) basin

Practice

10.1.14P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
- a) identify different types of hot water systems
- b) install different types of hot water systems
- c) troubleshoot different types of hot water systems
- d) maintain different types of hot water systems

Content

10.1.14P1 Identification of different types of hot water systems

10.1.14P2 Installation of different types of hot water system
- i) position of heating appliance
- ii) fixing the heating appliance
- iii) fixing the storage tank
- iv) piping
  - flow
  - return
- v) vent pipe
- vi) cold water supply pipe
- vii) fitting valves

10.1.14P3 Troubleshooting hot water systems
- i) air locking
- ii) water hammer
- iii) steam traps

10.1.14P4 Maintenance of hot water supply systems
- i) leakages
- ii) pipe lagging
- iii) testing

Suggested Teaching/Learning Resources

- Pipe
- Fittings
- Cistern
- Boiler (hot water)
- Calorifiers
- Lagging materials
- Model of hot water supply systems

10.1.15 LIFTS AND ESCALATORS

Theory

10.1.15T *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;

a) classify the different types of lifts
b) explain the working principle of different types of lifts
c) describe the features of a lift
d) classify the different types of escalators
e) explain the working principle of an escalator
f) describe the features of an escalator

10.1.15C Competence
The trainee should have the ability to:

i) install lifts and escalators
ii) troubleshoot lifts and escalators
iii) maintain lifts and escalators

Content

10.1.15T1 Classification of types of lifts
i) electric
ii) hydraulic

10.1.15T2 Working principle of lifts
i) electric
ii) hydraulic

10.1.15T3 Features of a lift
i) car
ii) motor
iii) doors
iv) control panel
v) guide rails
vi) pulleys
vii) steel ropes
viii) balance weight
ix) drum drive
x) deflector
xi) governor
xii) ram

10.1.15T4 Classification of escalators
i) single pass
ii) parallel
iii) crisscross

10.1.15T5 Working principle of escalators
i) single pass

ii) parallel
iii) crisscross

10.1.15T6 Features of an escalators
i) motor
ii) conveyor
iii) pump
iv) hand rails
v) governor
vi) brakes

Practice

10.1.15P *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to;
a) install lifts and escalators
b) troubleshoot lifts and escalators
c) maintain lifts and escalators

Content
10.1.15P1 Installation of lifts and escalators
10.1.15P2 Troubleshooting lifts and escalators
10.1.15P3 Maintenance of lifts and escalators

Suggested Teaching/Learning Resources
- Hydraulic pump
- Electric motor
- Control panel
- Gear box
- Conveyor
- Pulley
- Steel ropes
- Manuals
- Charts