12.1.01.0 WORKSHOP TECHNOLOGY

12.1.01.01 Introduction

This module unit is designed to equip the trainee with knowledge, skills and attitudes in engineering production processes with emphasis on high quality finishing processes when using machine tools, and varied engineering materials.

12.1.01.02 General Objectives

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

a) understand the importance of safety in the workshop environment
b) understand the production and uses of ferrous and non-ferrous metals
c) understand the working principles of measuring, marking out and inspection tools and equipment
d) acquire knowledge of various types of cutting fluids and lubricants
e) demonstrate care and maintenance on heat treatment equipment

12.1.01.03 Module Unit Summary Table and Time Allocation

Production Processes Technology 1

Code	Module Unit	Sub-Module Unit			
			Th.	Prac.	Total
12.1.01.1	Health and Safety	• Importance of safety • Factors which enhance safety • Electrical hazards • Fire hazards • Factory Acts Abstract • Machine and personal safety	2	2	4
12.1.01.2	Engineering Materials	• Types of engineering materials • Application of engineering	2	2	4

		materials • Production of metals • Properties of engineering materials • Material specification • Workshop tests • Safety precautions			
12.1.01.3	Materials Handling and Waste Disposal	• Methods of handling materials appropriately • The public procurement and disposal's act 2005 • Methods of disposing waste materials	2	2	4
12.1.01.4	Quality Control	• Meaning of quality control • Procedure of work process • Good workmanship • Factors contributing to marketability of a product	2	2	4
12.1.01.5	Measuring, Marking Out and Inspection	• Measuring, marking out and inspection tools • Parts of measuring instruments • Principles of measuring instruments • Gauge materials • Inspection tools • Nomenclature of	2	4	6

		marking out equipment • Materials for marking out equipment • Design features of equipment • Procedure for marking out • Care and maintenance of marking out measuring and inspection tools • Limits and fits • Types of fits • Uses of fits • Identification of fits • Types of tolerances • Calculation of clearances or interferences			
12.1.01.6	Hand Cutting and Forming Tools	• Hand and forming tools • Parts of hand tools • Materials for hand tools • Design features and construction • Use of hand tools • Care and maintenance	2	4	6
12.1.01.7	Machine Tools 1	• Types of machine tools • Machine tool construction and accessories • Tool and work holding • Machine	2	4	6

		operations • Cutting tool design • Cutting fluids and lubrication • Care and maintenance • Safety			
12.1.01.8	Culture of maintenance	• Meaning of culture of maintenance • Need for maintenance • Types of maintenance	2	0	2
12.1.01.9	Metal Joining I	• Joining methods • Tools and equipment • Procedure for making a joint • Defects in joints • Safety	2	4	6
12.1.01.10	Heat Treatment	• Term heat treatment • Heat treatment effects • Heat treatment processes • Purpose of heat treatment • Heat treatment process for a given metal • Cooling media • Heat Treatment equipment • Safety precautions	4	8	12
12.1.01.11	Finishing Processes	• Types of finishing processes • Techniques of finishing • Safety	2	6	8

		precautions • Care and maintenance of finishing tools and equipment			
12.1.01.12	Limits and Fits	• Types of fits • Uses of fits • Definition of common terms • Calculation of clearance and interferences	2	7	9
12.1.01.13	Sheet Metal Work	• Sheet metal tools and their uses • Sheet metal materials and their uses • Sheet metal forming processes • Safety	2	8	10
12.1.01.14	Metal Joining II	• Gas welding • Gas cutting • Manual metal arc welding • Metal Inert Gas (MIG) welding and • Tungsten Inert Gas (TIG) welding • Safety • Adhesives	4	14	18
Total Time			**108**		**99**

12.1.01.1 HEALTH AND SAFETY

Theory

12.1.01.1T0 Specific Objectives

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

a) explain the importance of safety in a workshop
b) state factors that enhance safety in the workshop
c) state the methods of stopping a machine in an emergency
d) explain the reasons for personal safety when working in a workshop
e) list the dangers associated with use of electricity in a workshop
f) explain the requirements of the factories act abstract and its relevance to general safety
g) explain First Aid procedures in the workshop
h) explain types of fires and methods of fighting them

Competence

The trainee should have the ability to:

i) stop a machine in an emergency
ii) demonstrate safe working habits in the workshop
iii) identify classes of fire and methods of fighting them
iv) demonstrate appropriate fire fighting skills
v) administer first aid to a victim
vi) identify exits, positions of fire extinguishers and first aid kits

Content

12.1.01.1T1 Importance of safety in a workshop
- i) accidents prevention to workers
- ii) accidents prevention to equipment

12.1.01.1T2 Factors enhancing safety
- i) rules
- ii) organization

12.1.01.1T3 Machine control emergency
- i) remote switches
- ii) main switches

12.1.01.1T4 Personal safety
- i) safety gear
- ii) Electricity hazards
- iii) electrocution
- iv) burning down
- v) damaging equipment

12.1.01.1T5 Factories Act Abstract
- i) personal safety
- ii) workshop requirement

iii) environmental safety

12.1.01.1T6 First Aid procedures for:
- i) burns
- ii) cuts and bruises (HIV risk)
- iii) electric shock
- iv) falls
- v) explosives

12.1.01.1T7 Types of fires
- i) Class A (paper, wood)
- ii) Class B (chemical fuel)
- iii) Class C (Electrical)
- iv) Fire Extinguishers
- v) water
- vi) asbestos blanket covering
- vii) CO2
- viii) foam
- ix) dry powder

Practice

12.1.01.1P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
- a) observe safety in the workshop
- b) identify and avoid dangerous situations in the workshop
- c) stop a machine in case of an emergency
- d) identify exits and positions of fire extinguishers and First Aid kits
- e) administer First Aid to a victim
- f) demonstrate appropriate fire fighting skills

Content

12.1.01.1P1 Observation of safety in the workshop
- i) correct, handling of tools
- ii) dressing
- iii) horse play
- iv) neatness in the workshop (spilt oil, clear gangway)

12.1.01.1P2 Dangerous situations in the workshop
- i) naked live electrical wires
- ii) avoid obnoxious gases
- iii) helmets (falls, splashes of acids)
- iv) fires (gaseous fuels and electrical faults)
- v) sharp edges/burns
- vi) noise
- vii) flying chips (goggles)
- viii) lifting heavy loads

12.1.01.1P3 Machine control
- i) remote controls
- ii) isolating switches
- iii) machine brakes

12.1.01.1P4 Identification of exits, positions of fire extinguishers and First Aid kits

12.1.01.1P5 Administration of First Aid
- i) mouth to mouth resuscitation
- ii) dressing wounds and cuts

12.1.01.1P6 Fire fighting drills

Suggested Teaching Methods

i) lecture
ii) charts
iii) videos
iv) demonstrations
v) illustration

Suggested Learning Resources

i) Working environment
ii) Up-to date fire fighting equipment
iii) Manufacturers' specifications
iv) Manuals

Suggested Assessment Methods

i) observations in a working environment
ii) C.A.Ts

12.1.01.2 ENGINEERING MATERIALS

Theory

*12.1.01.2T0 Specific Objectives*By the end of the sub module unit, the trainee should be able to;

a) list common engineering materials
b) distinguish ferrous and non-ferrous metals
c) explain the production and uses of ferrous and non-ferrous metals
d) explain mechanical properties and characteristics of common ferrous and non-ferrous metals
e) state the various forms of supply of engineering materials
f) explain correct workshop tests used to identify a given material
g) explain the safety precaution to be observed when handling engineering materials

Competence

The trainee should have the ability to:

i) identify various engineering materials
ii) select various materials for a given job
iii) handle material safely
iv) carry out various workshop tests on engineering materials (bend test, hardness test, spark test, ringing test)
v) demonstrate safety precautions when handling, using and storing Engineering materials

Content

12.1.01.2T1Common engineering materials

i) ferrous and non-ferrous metals

ii) plastics (thermosetting and thermoplastics)
iii) wood
iv) glass
v) ceramics composites

12.1.01.2T2 Distinguish between ferrous and non-ferrous metals

12.1.01.2T3 Production of ferrous metals
i) cast iron/pig iron
ii) plain carbon steel
iii) alloy steels
iv) Production and uses of non-ferrous metals
v) copper and its alloys
vi) aluminium and its alloys
vii) zinc and its alloys
viii) tin

12.1.01.2T4 Characteristics of common ferrous and non-ferrous metals
i) cast iron
ii) plain carbon steel
iii) alloy steels
iv) copper and its alloys
v) aluminum and its alloys
vi) zinc and its alloys
vii) tin

12.1.01.2T5 Forms of supply
i) flat bars
ii) round bar
iii) sheets
iv) plates
v) section (e.g. channel Z and I sections)
vi) tubes
vii) granules
viii) powder
ix) tablets

12.1.01.2T6 Workshop tests
i) spark test
ii) bend test
iii) ringing test

12.1.01.2T7 Safety precautions
i) personal
ii) material handling
iii) tools and equipment

Practice

12.1.01.2P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) identify common engineering materials
b) select materials for a given task/job
c) identify raw materials for the production of a given ferrous material
d) identify raw materials used in the production of non-ferrous metals
e) identify and operate various equipments used for the production of ferrous and non -ferrous metals
f) carry out various mechanical tests for ferrous and non-ferrous metals
g) identify various forms of supply of engineering

materials
h) carry out various workshop tests for ferrous and non-ferrous metals
i) observe safety precautions when handling, using and storing engineering materials.

Content

12.1.01.2P1 Identification of common engineering materials
- i) ferrous metals
- ii) non-ferrous metals
- iii) plastics (thermosetting and thermoplastics)
- iv) wood (hard and soft)
- v) ceramics
- vi) glass
- vii) composites

12.1.01.2P2 Selection of materials for a given task

12.1.01.2P3 Identification of raw materials for production of ferrous materials

12.1.01.2P4 Identification of raw materials for the production of non-ferrous materials

12.1.01.2P5 Operation of equipment for production of ferrous and non ferrous materials

12.1.01.2P6 Mechanical tests for ferrous and non-ferrous metals
- i) tensile test
- ii) hardness test
- iii) notch test/impact test

12.1.01.2P7 Forms of supply
- i) flat bar
- ii) round
- iii) plate
- iv) sheet
- v) sections
- vi) granules
- vii) powder
- viii) tablet

12.1.01.2P8 Workshop tests
- i) spark test
- ii) ringing test
- iii) bend test

12.1.01.2P9 Safety
- i) personal safety
- ii) equipment safety

Suggested Teaching Methods
- i) discussion
- ii) demonstration

Suggested Learning Resources
- i) specimens of various materials
- ii) furnace(s)
- iii) equipment(s) laboratory
- iv) slides (overhead projector)

Suggested Assessment Methods
- i) C.A.Ts
- ii) Oral/written tests
- iii) Laboratory report

12.1.01.3 MATERIALS HANDLING AND WASTE DISPOSAL

Theory

12.1.01.3T0 Specific Objectives
By the end of the sub module unit, the

trainee should be able to;

a) list various methods of handling materials appropriately

b) outline methods of disposing waste materials

Content

12.1.01.3T1 Methods of handling materials appropriately

i) delicate materials to be handled with care

12.1.01.3T2 Methods of disposing waste materials

i) burning: carbonaceous materials

ii) burying: broken glass or recycling

iii) feeding domestic animals with:

- food left-overs
- banana/ potato peelings

iv) recycling

- glass
- paper
- wood shavings
- textile wastes

Practice

12.1.01.3P0 Specific Objectives

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

a) identify appropriate methods of handling materials

b) demonstrate methods of disposing waste appropriately

Content

12.1.01.3P1 Appropriate methods of handling materials

i) heavy materials

ii) delicate materials

12.1.01.3P2 Appropriate methods of disposing waste

i) type of materials

ii) consider recycling

iii) environmental considerations

iv) Health and safety requirements

v) Local Authority's Bye-Law requirements on:

vi) Waste Disposal

vii) Siting of dump sites

viii) Proximity to

residential areas

ix) Proximity to water catchment areas

Competence
The trainee should have the ability to:
i) Identify appropriate methods of handling materials safely

ii) Demonstrate methods of disposing wastes appropriately

Suggested Teaching Methods
i) Demonstration on handling:

ii) Heavy materials

iii) Heavy objects

iv) delicate materials

Suggested Learning resources
i) Realia materials

ii) Dumping sites

Suggested Assessment Method
i) Practical exercises on handling

ii) heavy objects

iii) heavy materials

iv) delicate materials

12.1.01.4 QUALITY CONTROL

Theory

12.1.01.4T0Specific Objectives
By the end of the sub module unit, the trainee should be able to;
a) explain the meaning of quality control

b) outline the procedure of the work process

c) enumerate the advantages of good workmanship

d) list factors contributing to marketability of products

Competence
The trainee should have the ability to:
i) control work process

ii) ascertain good workmanship

iii) produce marketable products

Content
12.1.01.4T1Meaning of quality control
12.1.01.4T2Procedure of the work process
i) sequence of activities

12.1.01.4T3Advantages of good

workmanship
i) quality products

ii) customer satisfaction

12.1.01.4T4 Factors contributing to marketability of products
i) Durability

ii) Finishing

iii) Quality of selected materials

iv) Intended purpose

Practice

12.1.01.4P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) control the work process

b) ensure good workmanship

c) produce marketable products

Content

12.1.01.4P1 Control the work process
- sequencing of activities

12.1.01.4P2 Ensure good workmanship
i) quality products

ii) customer satisfaction

12.1.01.4P3 Marketable products
i) durability

ii) finishing

iii) quality of selected materials

iv) serves intended purpose

Suggested Teaching Methods
i) illustration on:

- methods of controlling work processes

- identify qualities of good workmanship

- techniques of producing marketable products

Suggested Learning resources
i) Manufactured products

ii) materials selection

iii) workmanship

iv) finishing techniques

v) Aesthetic value of the products

Suggested Assessment Method
i) Producing items of

high quality

ii) Producing items to specifications

iii) Satisfying needs of the customer

12.1.01.5 MEASURING, MARKING OUT AND INSPECTION

Theory

12.1.01.5T0Specific Objectives

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

a) differentiate between measuring and inspection
b) name various measuring and inspection tools
c) explain the principle of measuring and inspection tools
d) name the materials from which gauges are made
e) state various marking out tools and equipment
f) name the parts of marking out tools and equipment
g) name the materials from which the marking out tools and equipment are made from
h) describe the design features of marking out equipment
i) explain the procedure for marking out various projects.
j) explain the correct method of caring and maintaining the tools.

Competence

The trainee should have the ability to:

i) identify marking out tools
ii) use marking out tools correctly
iii) care and maintain measuring ,marking out, and inspection tools
iv) work safely with measuring, inspection and marking out tools

Content

12.1.01.5T1Differentiating between measuring and inspection

12.1.01.5T2Naming of tools

i) Measuring
   - Micrometer
   - Vernnier caliper
   - Combination set
   - Vernnier protractor
   - Inspection
   - Spirit level
   - Dial test indicator (DTI)
   - Line bar

12.1.01.5T3Principles of measuring and inspection tools

i) Function of part

ii) Accuracy

12.1.01.5T4 Naming materials for gauges
- i) Plug
- ii) Gap
- iii) Ship/block
- iv) Ring
- v) Feeler
- vi) Screw pitch
- vii) Angle gauges (angled blocks)

12.1.01.5T5 Stating marking out tools and equipment
- i) Marking out table
- ii) Surface plate
- iii) Angle plate
- iv) Vee block
- v) Vernnier height gauge
- vi) Scribing block
- vii) Combination set
- viii) Dividers
- ix) Odd leg calipers
- x) Centre punch
- xi) Scribers
- xii) Steel rule
- xiii) Try square

12.1.01.5T6 Naming parts of marking out tools and equipment

12.1.01.5T7 Materials for marking out tools and equipment (stated above)

12.1.01.5T8 Design features of marking out tools and equipment

12.1.01.5T9 Procedure for marking out

12.1.01.5T10 Care and maintenance of:
- i) Measuring and inspection tools
- ii) Marking out tools and equipment

Practice

12.1.01.5P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
- a) select the appropriate measuring and inspection instrument for a given job
- b) use the measuring and inspection tool correctly
- c) care and maintain the instrument
- d) select the appropriate equipment for marking out
- e) demonstrate the proper procedures when marking out
- f) care and maintain the marking out equipment

Content

12.1.01.5P1 Selection of measuring and inspection instruments

12.1.01.5P2 Measuring instruments
- i) micrometer (external, internal, depth)
- ii) vernnier caliper
- iii) vernnier protractor
- iv) combination set
- v) spirit level
- vi) sine bar
- vii) sine table
- viii) Dial Testing

Indicator (D.T.I)
ix) Inspection Instrument
x) gauges
xi) Spirit level
xii) DTI
xiii) Usage of the instruments
xiv) condition of the instrument
xv) handling
xvi) measurement

12.1.01.5P3 Care and maintenance of the instruments
i) handling
ii) cleaning and oiling
iii) storage

12.1.01.5P4 Selecting Equipment for marking out

12.1.01.5P5 Demonstrate the proper procedures when marking out
i) preparation of work surface
ii) setting up the work
iii) scribing of lines and arcs
iv) centre punching
v) caring and maintaining equipment
vi) handling
vii) cleaning and oiling
viii) storage

12.1.01.5P6 Care and maintenance of the marking out tools & equipment
i) Condition of instrument/tool
ii) Handling
iii) Storage

Suggested Teaching Methods
i) discussion
ii) demonstration
iii) practical exercises/assignments

Suggested Learning Resources
i) measuring, inspection and marking out tools (see above)
ii) videos and slides (overhead projector
iii) charts
iv) software (power point)

Suggested Assessment Methods
i) practical tests on measuring observations
ii) continuous assessment tests (C.A.Ts)
iii) oral/written tests

12.1.01.6 HAND CUTTING AND FORMING TOOLS

Theory

12.1.01.6T0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) name hand tools and their specific parts
b) name the materials from which the tools are made
c) describe the design features and construction of

hand tools
d) explain the correct procedure for using the hand tools
e) explain the proper method of caring and maintaining the hand tools.

Competence

The trainee should have the ability to:
i) select appropriate tool for a given task
ii) set and use tool correctly

Content

12.1.01.6T1 Hand tools
i) chisel
ii) taps and dies
iii) reamers
iv) scrapers
v) hacksaw
vi) snips
vii) files
viii) pipe cutter
ix) hammers
x) mallets
xi) stakes
xii) fullers
xiii) anvil
xiv) swages
xv) swage clock
xvi) flatters
xvii) formers

12.1.01.6T2 Materials for hand tools as stated in hand tools above

12.1.01.6T3 Design features and construction of the tools
i) shape
ii) material
iii) purpose

12.1.01.6T4 Correct use of hand tools
i) positioning of work piece
ii) tool holding and manipulation
iii) posture
iv) pressure application
v) Care and maintenance of hand tools
vi) tool selection
vii) handling
viii) cleaning/conditioning
ix) storage

Practice

12.1.01.6P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) select the appropriate tool for a given task
b) use the tool correctly
c) practice safe working habits
d) care and maintain the tools

Content

12.1.01.6P1 Selection of the tool for;
i) chipping
ii) tapping
iii) reaming
iv) scraping
v) sawing
vi) shearing
vii) filing
viii) forming
ix) twisting
x) flattering

xi) punching
xii) bending

12.1.01.6P2 Usage of the tools
i) correct clamping of work piece
ii) correct posture
iii) correct tool handling
iv) correct pressure and strokes
v) reconditioning of tools

12.1.01.6P3 Safety
i) personal safety
ii) tools and equipment safety

12.1.01.6P4 Care and maintenance
i) handling
ii) cleaning
iii) storage

Suggested Teaching Methods
i) demonstration on;
ii) correct use of the tools
iii) sharpening of tools
iv) illustrations on;
v) various hand tools
vi) discussions

Suggested Learning Resources
i) realia (hand tools)
ii) relevant reference books
iii) charts
iv) overhead projector/LCD

Suggested Assessment Method
i) quizzes/assignments
ii) practical project work
iii) examinations

12.1.01.7 MACHINE TOOLS 1

Theory

12.1.01.7T1 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) name various types of machines tools
b) name the various parts of machine tools and their accessories
c) explain the procedure of mounting the tool and work correctly
d) explain the operations of machine tools correctly
e) explain the functions of various tool angles
f) name various types of cutting fluids and lubricants
g) explain the purpose of using cutting fluids and lubricants
h) explain the proper methods of caring and maintaining various machine tools
i) state the safety precautions to be observed when using a machine tool.

Competence

The trainee should have the ability to:

i) identify various types of machine tools
ii) identify parts of machine tools and accessories
iii) mount tool and work correctly
iv) operate machine tools correctly
v) grind tool angles correctly
vi) identify types of cutting fluids
vii) apply correct cutting fluids for a given task
viii) carry out proper care and maintenance on machine tools and their accessories
ix) observe safety precautions

Content

12.1.01.7T1 Types of machine tools
i) Pedestal grinder and hand grinder
ii) Power saw
iii) drilling machine
iv) centre lathe
v) Shaping machine
vi) milling machine

12.1.01.7T2 Parts and Accessories of machine tools (above)

12.1.01.7T3 Work and Tool Mounting
i) tool setting
ii) work setting

12.1.01.7T5 Operation of Machine Tools
i) Power saw
- cutting
- Drilling machine
- hole drilling and reaming
- Centre lathe
- Facing
- Plain turning
- Drilling and boring
- Taper turning
- Knurling
- Shaping machine
- Plain
- Serrations
- Angular cutting
- Milling machine
- Plain milling
- Gang milling
- Straddle milling

ii) Grinding
- Types of grinding machines
- pedestal
- angle grinder
- Features of grinding machines
- Pedestal
- motor casing
- spindle
- tool test
- wheel guard
- screen
- Angle grinder
- main body
- switch
- wheel spindle
- Features of grinding wheel
- Abrasive
- natural (sandstone, quartz, garnet)

- artificial (SiC, Al2O3, Boron carbide)
- Bonds (rubber, shellac, Ocychloride, Resinod, Vitrified)
- Structure
- Grit size
- Grade
- Mounting, dressing and truing
- Safety
- personal safety
- equipment safety
- Tool angles
- rake
- clearance
- point angle
- relief angle

12.1.01.7T6Types of Cutting Fluids and Lubricants
i) soluble oils
ii) lubricants
iii) water
iv) Functions of Cutting Fluids
v) cooling of work and tool
vi) lubrication
vii) washing away swaps

12.1.01.7T7Care and Maintenance
i) cleaning
ii) oiling
iii) reconditioning
iv) storage

12.1.01.7T8Safety
i) personal
ii) equipment/tool

Practice

12.1.01.7P0Specific Objectives

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

a) identify various types of machine tools
b) identify various parts of machine tools and their accessories
c) mount the tool and work correctly
d) operate various machine tools correctly
e) identify various types of cutting fluids for a given task
f) carry out proper care and maintenance of various machine tools and their accessories
g) observe safety precautions when using various machine tools.

Content

12.1.01.7P1Types of machine tools
i) power saw
ii) drilling machine
iii) centre lathe
iv) shaping machine
v) milling machine
vi) grinding

12.1.01.7P2Identification of machine tool parts and accessories

12.1.01.7P3 Mounting of various machine tools correctly

12.1.01.7P4 Operation of various machine tools

12.1.01.7P5 Cutting fluids and lubricants
- i) soluble oils
- ii) lubricants
- iii) water
- iv) Application of cutting fluids
- v) ferrous metals
- vi) non ferrous metals
- vii) plastics
- viii) ceramics

12.1.01.7P6 Care and maintenance
- i) oiling
- ii) cleaning
- iii) reconditioning
- iv) storing

12.1.01.7P7 Safety
- i) personal
- ii) equipment

Suggested Teaching Methods
- i) Demonstration on:
  - tool and work mounting
  - operating various machine tools
  - tool grinding
  - care and maintenance of machine tool
- ii) Illustration on:
  - machine tools
  - parts of machine tools
  - application of coolants
  - Discussion

Suggested Learning Resources
- i) realia (machine tools)
- ii) realia (cutting tools)
- iii) relevant reference books
- iv) charts
- v) overhead projector/lcd

Suggested Assessment Method
- i) quizzes/assignment
- ii) practical project work
- iii) examination

12.1.01.8 CULTURE OF MAINTENANCE

Theory

12.1.01.8T0 Specific Objectives

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

a) explain the meaning of culture of maintenance

b) explain the need for maintenance

c) describe types of maintenance

Competence

The trainee should have the ability to:

i) explain meaning of culture of maintenance

ii) illustrate need for maintenance

iii) discuss

maintenance procedures

iv) observe safety rules

v) cost tasks

Content

12.1.01.8T1 Explaining the culture of maintenance

12.1.01.8T2 Explaining the need for maintenance

i) restoring good working order

ii) tools

iii) materials

iv) equipment

v) structure

vi) components

vii) maintaining health standards

viii) avoiding deterioration or decay of the components/materials/tools/equipment

12.1.01.8T3 Types of maintenance

i) routine maintenance

ii) preventive maintenance

iii) planned maintenance

Practice

12.1.01.8P0 Specific Objectives

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

a) justify need for maintenance

b) discuss maintenance procedure

c) observe safety precautions during maintenance

d) costing maintenance tasks

Content

12.1.01.8P1 Justifying need for maintenance

i) observing

ii) recording

iii) reporting

iv) costing the tasks

12.1.01.8P2 Maintenance procedures

i) identification

ii) trouble shooting analysis

iii) operations implications

iv) cost implications

v) procurement of components/parts

vi) actual maintenance

vii) testing

12.1.01.8P3 Observe safety precautions

i) care for existing undamaged parts or components

ii) personal safety

iii) materials safety

iv) other operatives safety

v) tools and equipment safety

12.1.01.8P4 Costing maintenance tasks

i) materials estimation

by:

- calculation
- past experience/similar tasks
- labour requirements and availability
- types of labour
- skilled
- semi-skilled
- casual
- availability
- skills assessment
- number of persons required for the task(s)
- maintenance time/duration

ii) alternative arrangement at time of maintenances

- cost implication
- convenience
- costing works/tasks
- materials cost
- item cost
- transport cost
- cost of storage
- storage safety
- contingencies
- labour cost
- profit and over heads

Suggested Teaching Methods

i) Illustration on:

ii) Need for maintenance

iii) Maintenance procedures

iv) Methods of working safely

Suggested Learning resources

i) materials that require maintenance

ii) tools that require maintenance

iii) Manuals

Suggested Assessment Method

i) Practical exercises on:

ii) Identifying tools that require maintenance

iii) Maintaining tools

iv) Costing tasks that require maintenance

12.1.01.9 METAL JOINING 1

Theory

12.1.01.9T0 Specific Objectives

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

a) state various joining methods
b) list tools and equipment for the joining methods in (a) above
c) explain the proper procedure of making joints
d) state various defects in joints
e) state safety precautions to be observed when metal joining

Competence

The trainee should have the ability to:

i) make a mechanical joint
ii) make a soldered joint
iii) carry out gas welding operation
iv) carry out arc welding operation
v) spot welding
vi) identify defects
vii) care and maintenance of tools and equipment
viii) demonstrate safe working habit in respect of personal and equipment safety

Content

12.1.01.9T1 Joining methods

i) Mechanical
ii) bolts, nuts, studs and screws
iii) locking devices for nuts
iv) bevel and taper pins
v) rivets and keys
vi) Thermal
vii) Soldering (soft and hard)
viii) Gas welding
ix) Arc welding
x) Spot welding

12.1.01.9T2 Tools and equipment for processes above

12.1.01.9T3 Joint preparations

12.1.01.9T4 Joint defects

12.1.01.9T5 Safety

i) Personal safety
ii) Equipment safety

Practice

12.1.01.9P0 Specific Objectives

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

a) select appropriate

joining method for a given job
b) perform a given joining task using suitable tools and equipment
c) identify defects in metal joints
d) demonstrate safe working habit when performing metal joining tasks.

Content

12.1.01.9P1 Selection of joining method
i) Mechanical
ii) bolts and nuts
iii) studs and screws
iv) rivets
v) keys
vi) pins
vii) Thermal

12.1.01.9P2 Performing a given task
i) prepare work piece
ii) select suitable tools and equipment
iii) make joints using right methods
iv) inspecting and testing the joint

12.1.01.9P3 Identify defects
i) Care and maintenance of tools
ii) cleaning
iii) handling
iv) storing

12.1.01.9P4 Safety
i) personal safety
ii) equipment safety

Suggested Teaching Methods
i) discussions
ii) illustrations
iii) demonstrations

Suggested Learning Resources
i) supply of various mechanical fasteners
ii) gas welding equipment
iii) soldering equipment
iv) arc welding equipment
v) spot welding equipment

Suggested Assessment Method
i) C.A.Ts
ii) practical exercises
iii) oral/written tests
iv) project work

12.1.01.10 HEAT TREATMENT

Theory

12.1.01.10T0 Specific Objectives
By the end of the sub module unit, the trainee should be able to;
a) explain the term heat treatment
b) describe effects of heat treatment on metals
c) explain types of heat treatment processes
d) explain the purpose of heat treatment processes
e) state heat treatment processes appropriate for a given metal

f) explain types of cooling media
g) describe a given equipment used for heat treatment process
h) explain safety precautions during heat treatment process

Competence

The trainee should have the ability to:

i) select appropriate heat treatment equipment and cooling media for a given task
ii) perform heat treatment processes
iii) perform tests on heat treated work pieces
iv) demonstrate safety when handling heat treatment processes

Content

12.1.01.10T1 Term heat treatment

12.1.01.10T2 Heat treatment effects
- i) re-structure
- ii) refining of grains

12.1.01.10T3 Heat treatment process
- i) hardening
- ii) tempering
- iii) annealing
- iv) normalizing
- v) case hardening

12.1.01.10T4 Purpose of heat treatment
- i) hardening
- ii) toughening
- iii) softening
- iv) relieving internal stress
- v) Heat treatment of specific metals
- vi) Carbon steels
- vii) Aluminium and its alloys
- viii) Copper and its alloys

12.1.01.10T5 Cooling media
- i) air
- ii) water
- iii) brine
- iv) acids
- v) sand
- vi) ash

12.1.01.10T6 Heat treatment equipment
- i) furnaces
- ii) gas flames
- iii) forge
- iv) temperature measuring equipment

12.1.01.10T7 Safety
- i) personal safety
- ii) equipment safety

Practice

12.1.01.10P0 Specific Objectives

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

a) select the appropriate heat treatment equipment and

cooling media for a given task
b) perform a heat treatment process
c) perform workshop test on heat treated work piece
d) care and maintain heat treatment equipment
e) practice safety during heat treatment processes

Content

12.1.01.10P1 Heat treatment equipment and cooling media for the following tasks
i) hardening
ii) heating temperature
iii) cooling media
iv) Tempering
v) meeting temperature
vi) cooling media
vii) Annealing
viii) heating temperature
ix) cooling media
x) Normalising
xi) heating temperature
xii) cooling media
xiii) Case hardening
xiv) heating temperature
xv) cooling media

12.1.01.10P2 Heat treatment processes
i) preparing the work-piece
ii) setting up the equipment
iii) correct heating
iv) correct cooling

12.1.01.10P3 Workshop test
i) filing
ii) impact test

12.1.01.10P4 Care and maintenance
i) handling
ii) usage
iii) storage

12.1.01.10P5 Safety
i) personal safety
ii) equipment safety

Suggested Teaching Methods
i) demonstrations on heat treatment processes
ii) illustrations
iii) discussions
iv) notes taking

Suggested Learning Resources
i) heat treatment furnaces
ii) temperature measuring equipment
iii) cooling tanks and medias
iv) realia
v) charts
vi) overhead projectors/LCD
vii) relevant text books

Suggested Assessment Methods
i) practical exercises
ii) quizzes
iii) C.A.Ts
iv) oral/written tests

12.1.01.11 FINISHING PROCESSES

Theory

12.1.01.11T1Specific Objectives

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

a) name types of finishing processes
b) explain proper procedure in finishing processes in (a) above
c) explain methods of caring and maintaining tools and equipment in finishing processes
d) state safety precautions to be observed in finishing processes.

Competence

The trainee should have the ability to:

i) select a suitable finishing process for a given task
ii) carry out a finishing process correctly
iii) service and maintain finishing processes equipment
iv) work safely with finishing processes equipment

Content

12.1.01.11T1Types of finishing processes

i) Bluing
ii) Lacquering
iii) Blackening
iv) Polishing
v) Coating
vi) Varnishing

12.1.01.11T2Procedures in finishing

i) preparation
ii) treatment
iii) storage

12.1.01.11T3Care and maintenance

i) cleaning
ii) oiling and greasing
iii) contamination (coating processes)

12.1.01.11T4Safety

i) personal safety
ii) equipment safety

Practice

12.1.01.11P1Specific Objectives

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

a) select a finishing process for a given task
b) carry out a given finishing process correctly
c) care and maintain tools and equipment used for finishing process
d) demonstrate safe working habit when carrying out a finishing process

Content

12.1.01.11P1Selection of a finish process

i) bluing
ii) lacquering
iii) blackening
iv) polishing
v) coating
vi) varnishing

12.1.01.11P2 Carrying out a given finishing process correctly

12.1.01.11P3 Care and maintenance of finishing processes equipment

12.1.01.11P4 Safety
- i) personal safety
- ii) equipment safety

Suggested Teaching Methods
- i) discussion/lecture notes
- ii) demonstrations
- iii) videos, films

Suggested Learning Resources
- i) textbook
- ii) specimen
- iii) finishing processes equipments

Suggested Assessment Methods
- i) written tests
- ii) practical tests

12.1.01.12 LIMITS AND FITS

Theory

12.1.01.12T0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
- a) define various types of fits
- b) explain various uses of fits
- c) define common terms used in limits and fits systems
- d) explain types of tolerances

Competence

The trainee should have the ability to:
- i) select suitable type of fit for a given job
- ii) produce a project to a given fit

Content

12.1.01.12T1 Definition of fits
- i) interference
- ii) clearance
- iii) transition

12.1.01.12T2 Use of fits
- i) driving fit
- ii) shrinking
- i) running fit
- ii) force fit

12.1.01.12T3 Definition of common terms
- i) tolerances
- ii) upper limit
- iii) lower limit
- iv) allowance

12.1.01.12T4 Types of tolerances
- i) unilateral
- ii) bilateral
- iii) Calculation of clearances and interferences

Practice

12.1.01.12P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
- a) select suitable type of fit for a given job
- b) produce a project to given limits

Content

12.1.01.12P1 Selection of suitable type of fit
- Machining to given limits

Suggested Teaching Methods
i) lecture/discussion
ii) demonstrations
iii) illustrations
iv) videos

Suggested Learning Resources
i) textbooks
ii) specimens
iii) charts
iv) measuring tools

Suggested Assessment Methods
i) practical exercises
ii) written tests

12.1.01.13 SHEET METAL WORK

Theory

12.1.01.13T1 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) explain the correct use of given sheet metal tools
b) differentiate various materials used in sheet metal work
c) state the uses of various sheet metal materials
d) explain various sheet metal forming processes
e) explain safety precautions to be observed when carrying out sheet metal forming processes

Competence

The trainee should have the ability to:
i) select appropriate sheet metal tools for a given job
ii) produce various sheet metal articles using a given sheet forming process
iii) care for and maintain sheet metal tools and equipment
iv) observe safety when performing any sheet metal forming processes.

Content

12.1.01.13T1 Sheet metal tools
i) snips
ii) stakes
iii) mallets
iv) folding bars
v) anvil
vi) grooving sets
vii) pliers
viii) hammers
ix) punches
x) chisels
xi) Uses of the above tools

12.1.01.13T2 Sheet metal materials
i) tinplate
ii) galvanized sheet
iii) mild steel

iv) aluminium
v) stainless steel

12.1.01.13T3 Uses of sheet metal materials

12.1.01.13T4 Sheet metal forming processes
i) raising
ii) hollowing
iii) drawing
iv) beading
v) punching
vi) grooving
vii) knocked-up seam

12.1.01.13T5 Safety
i) personal safety
ii) equipment safety

Practice

12.1.01.1301 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) select appropriate sheet metal tools for a given job
b) produce various sheet metal articles using a given sheet metal forming process
c) demonstrate safe working habits when using sheet metal tools and materials

Content

12.1.01.13P1 Selecting sheet metal tools
i) snips
ii) stakes
iii) mallets
iv) folding bars
v) anvil
vi) grooving sets
vii) pliers
viii) hammers
ix) punches
x) chisels

12.1.01.13P2 Production of Sheet metal articles
i) Application of various skills
- hollowing
- raising
- beading
- drawing
- punching
- grooving
- knocked up seam

ii) finishing
- quality control
- costing

12.1.01.13P3 Safety
i) personal safety
ii) equipment safety

Suggested Teaching Methods
i) demonstrations on various sheet metal forming processes
ii) illustrations
iii) notes taking

Suggested Learning Resources
i) realia
ii) charts/diagrams
iii) relevant text books

Suggested Assessment Methods
i) practical exercises
ii) assignments
iii) observations
iv) written exams

12.1.01.14 METAL JOINING PROCESSES 11

Theory

12.1.01.14T1 Specific Objectives	*Content*
By the end of the sub module unit, the trainee should be able to; a) explain the principle of gas welding process b) name various gas welding joints c) explain gas welding techniques d) name gas cutting accessories e) explain the principle of gas cutting f) explain the principle of arc welding process g) name various arc welding joints h) explain the arc welding of a given metal i) name equipment and tools for MIG and TIG welding process j) explain the principles of MIG and TIG welding processes k) explain various adhesives used for joining l) observe safety precautions for a given type of welding process	12.1.01.14T1Principle of gas welding 12.1.01.14T2 Gas welding joints i) butt ii) lap iii) corner iv) fillet v) edge 12.1.01.14T3 Gas welding techniques i) leftward ii) rightward iii) positional welding 12.1.01.14T4Gas cutting accessories i) cutting nozzle ii) gas cutting guides iii) gas cutting trammel 12.1.01.14T5Gas cutting (principle) i) pre-heating ii) cutting stream (oxygen) iii) speed of travel iv) selection of nozzle 12.1.01.14T6Principle of arc welding process 12.1.01.14T7Arc welding joints i) butt ii) fillet iii) corner iv) lap v) edge 12.1.01.14T8Arc welding of a given metal i) mild steel ii) cast iron 12.1.01.14T9MIG and TIG welding equipment

i) inert gas cylinders
ii) filler wire/electrode
iii) MIG welder and accessories
iv) TIG welder and accessories

12.1.01.14T10 Principles of MIG and TIG welding processes

12.1.01.14T11 Adhesives for joining

12.1.01.14T12 Safety precautions for a given welding process
i) personal (operator)
ii) equipment

Practice

12.1.01.14P0 Specific Objectives

By the end of the sub module unit, the trainee should be able to;
a) carry out gas welding operations
b) execute a given gas welding joint using correct welding techniques
c) execute gas cutting operations for a given metal
d) carry out arc welding operations for a given metal
e) perform MIG and TIG welding operations
f) practice safety when performing a given type of welding process

Competence

The trainee should have the ability to:
i) carry out gas welding operations using welding technique
ii) execute a given welding joint
iii) execute gas cutting operation for a given metal
iv) carry out arc welding operation
v) perform MIG and TIG welding operation
vi) practice safe working habits when performing welding process

Content

12.1.01.14P1 Gas welding operations
i) flame setting
ii) selection of nozzle
iii) filler metal
iv) parent metal
v) leftward welding technique
vi) rightward welding techniques
vii) positional welding
viii) overhead
ix) vertical up/down
x) horizontal

12.1.01.14P2 Welding joints

		using: i) Butt ii) Lap iii) Corner iv) filler
12.1.01.14	P3	Gas cutting operation i) flame setting ii) nozzle selection iii) pre-heating
12.1.01.14	P4	Arc welding operation i) selection of electrode ii) current setting iii) electrode angle iv) speed of travel v) flat vi) positional welding
12.1.01.14	P5	MIG and TIG welding operation i) type of inert gas ii) filler wire iii) base metal iv) speed control
12.1.01.14	P6	Safety precautions i) personal safety ii) equipment safety

Suggested Teaching Methods

i) demonstrations
ii) illustrations
iii) discussions
iv) industrial visits

Suggested Learning Resources

i) charts
ii) realia
iii) relevant textbooks
iv) overhead projector/laser compact disc (LCD)
v) transparencies

Suggested Assessment Methods

i) C.A.Ts
ii) quizzes
iii) oral questions
iv) assignments
v) Practical exercises