

## 10.1.0 MATERIALS, PROCESSES AND WORKSHOP PRACTICE

### 10.1.01 Introduction

This module unit is intended to equip the trainee with the necessary knowledge, skills and attitude required to understand the concepts of materials, processes and workshop practice and their application in the field of electrical and electronic engineering

### 10.1.02 General Objectives

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

- a) Observe safety rules and regulations in the workshop
- b) Acquire knowledge of engineering materials and processes
- c) Create awareness of the human aspect of error in handling tools and equipment.
- d) Appreciate quality of finished products

### 10.1.03 Module Unit Summary and Time Allocation

#### Materials, Processes and Workshop Practice

Code	Sub-Module Unit	Content	Time Hrs
10.1.1	Workshop Safety	<ul style="list-style-type: none"><li>• General workshop safety</li><li>• Causes of accidents</li><li>• Industrial safety</li><li>• Classification of fires</li><li>• Electrical safety</li><li>• Workshop layout</li></ul>	10
10.1.2	Materials and Processes	<ul style="list-style-type: none"><li>• Metals, non- metals and alloys</li><li>• Properties of materials</li><li>• Extraction processes</li><li>• Finishes and decorative process</li><li>• Electrical materials and applications</li><li>• Metal forming processes</li></ul>	6
10.1.3	Metal Shop Tools and Measurements	<ul style="list-style-type: none"><li>• Term used in measurement</li><li>• Marking out techniques</li><li>• Workshop hand tools</li></ul>	12
10.1.4	Joining of Metals	<ul style="list-style-type: none"><li>• Mechanical joining of metals</li><li>• Thermal joining</li></ul>	12

10.1.5	Workshop Machines and Applications	<ul style="list-style-type: none"> <li>• Workshop machines</li> <li>• Operation of different types</li> <li>• Safety precautions while using various machines</li> </ul>	10
10.1.6	Sheet Metal Work	<ul style="list-style-type: none"> <li>• Common sheet metals</li> <li>• Uses of tools</li> <li>• Forming in sheet metal</li> <li>• Edge treatment of joints</li> <li>• Fabrication machines</li> </ul>	16
<b>Total Time</b>			<b>66</b>

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## 10.1.1 WORKSHOP SAFETY

### Theory

#### 10.1.1T0 *Specific Objectives*

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

- a) explain the safety regulations in the workshop
- b) explain courses of accidents in a workshop
- c) outline legislation regarding industrial safety
- d) explain classification of methods of extinguishing fires
- e) explain electrical safety in the buildings
- f) explain factors considered in workshop layout

#### *Contents*

- 10.1.1T1 General workshop safety
- 10.1.1T2 Courses of accidents
- 10.1.1T3 Industrial safety
  - i) Factory's and other places of work Act
  - ii) Special regulations
  - iii) Hazardous areas
- 10.1.1T5 Classification of fires
  - i) Fire fighting procedure
  - ii) Extinguishers
- 10.1.1T6 Electrical safety
  - i) Preventive measures
  - ii) Treatment of electric shock
  - iii) Mouth to mouth
  - iv) Holger Nelson method
- 10.1.1T7 Workshop layout
  - i) Factors

- ii) Location
- iii) Material handling
- iv) Storage
- v) Safety
- vi) Aesthetic
- vii) Plan of workmanship
- viii) Machine layout
- ix) Electrical supply

### Practice

#### 10.1.1P0 *Specific Objectives*

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

- a) identify sources safety hazards in the workshop
- b) apply appropriate preventive measures against workshop hazards
- c) perform first aid
- d) carry out fire extinguishing drills for various classes of fire

#### *Content*

- 10.1.1P1 Identification of safety hazards in the workshop
  - i) Slippery floors
  - ii) Rotating machines
  - iii) Horse play
  - iv) Bare live cables
  - v) Tools handling
  - vi) Defective tools
  - vii) Machines and situations
- 10.1.1P2 Application of appropriate preventive measures
  - i) Clothing
  - ii) Hand tools
  - iii) Machine tools
  - iv) Electrical accidents
  - v) Fires
  - vi) Glare
  - vii) Radiation

- viii) Machine guard
  - ix) Ultra violet light
  - x) Cleanliness
  - xi) First aid
  - xii) Gang ways
- 10.1.1P3 First aid
- i) The need for a first aid kit
  - ii) The content of a first aid kit and
  - iii) Their applications
  - iv) Care for a first aid kit
  - v) Burns
  - vi) Electric shock
  - vii) Cuts and HIV and aids prevention
  - viii) Toxic materials
  - ix) HIV and aids prevention and wound cleaning and dressing
  - x) Assessing the need for a physician
- 10.1.1P4 Fire extinguishing drills

- 10.1.1C **Competence**  
The trainee should have the ability to:
- Demonstrate the knowledge of safety in work places
  - Handle a first aid kit
  - Perform first aid
  - Identify and sources of accidents and prevent the same

*Suggested teaching/Learning Activities*

- Discussion
- Illustration
- Demonstration
- Note taking
- Practical exercise

*Suggested Learning Resources*

- i) Protective clothing
- ii) First aid kit
- iii) First aid specialist (personnel)
- iv) Teachers notes
- v) Fire extinguishers
- vi) Charts on safety
- vii) Resource persons for fire fighting

*Suggested Evaluation Methods*

- Oral tests
- Timed written tests
- Assignments
- Timed practical tests
- Project

**10.1.2 MATERIALS AND PROCESSES**

**Theory**

- 10.1.2T0 *Specific Objectives*  
By the end of the sub-module unit, the trainee should be able to:
- a) distinguish between metals non metals and alloys
  - b) explain the properties of engineering materials
  - c) explain methods of extraction of different materials
  - d) explain finishes and decorative process of materials
  - e) explain the properties electrical materials and their applications

	f) explain the various methods of metal forming processes		v) Construction of cables vi) Cable sizes
	<i>Content</i>	10.1.2T6	Metal forming processes i) Forging-folding ii) Foundry work/casting iii) Filing, bending and threading
10.1.2T1	Metals and non- metals i) Metals ii) Non metals iii) Alloys iv) Ferrous metal v) Non ferrous metals		<b>Practice</b>
10.1.2T2	Properties of materials i) Ductility ii) Toughness iii) Strength iv) Hardness v) Malleability vi) Corrosion vii) Resistance viii) Heat treatment ix) Conductivity	10.1.2P0	<i>Specific Objectives</i> By the end of the sub-module unit, the trainee should be able to: a) identify ferrous and non ferrous materials b) identify plastics materials c) identify various types of cables
10.1.2T3	Extraction process i) Iron ii) Steel iii) Alluminium iv) Copper v) Bronze vi) Plastic materials		<i>Content</i>
10.1.2T4	Finishes and decorative process i) Picking and cleaning ii) Polishing iii) Electroplating iv) Colouring v) Lacquering vi) Enamelling vii) Etching	10.1.2P1	Ferrous material i) Iron ii) Steel iii) Alloy steel
10.1.2T5	Engineering materials and applications i) Conductors and application ii) Insulators and application iii) Semi – conductors and application iv) Properties	10.1.2P2	Non ferrous materials i) Alluminium ii) Bronze iii) Zinc iv) Copper v) Brass vi) Tin
		10.1.2P3	Plastic materials i) Polyvinyl chloride (PVC) ii) Rubber iii) Mica iv) Wood v) Porcelain vi) Synthetic materials
		10.1.2P4	Cables i) Construction ii) Extrusion iii) Drawing iv) Rolling

- v) Stranding
- vi) Insulating and sheathing

### 10.1.2C Competence

The trainee should have the ability to:

- i) Identify various materials used in the engineering field
- ii) Select various materials for various applications
- iii) Safety in handling materials in engineering field

#### *Suggested Learning Resources*

- Metals – ferrous and non ferrous
- Alloys
- Plastics
- Ceramics
- Fibre glass
- Synthetic materials
- Rubber
- Charts
- Reference books
- Internet

### 10.1.3 METAL SHOP TOOLS AND MEASUREMENTS

#### 10.1.3 *Specific Objectives*

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

- a) define terms used in workshop measurement
- b) explain marking out techniques
- c) state correct use of workshop tools

#### *Content*

- 10.1.3T1 Term used in measurement
  - i) Scales – linear and non linear
  - ii) Tolerance
  - iii) Limits
  - iv) Fits

#### 10.1.3T2 Marking out techniques

- i) Line and measurement
- ii) Use of rulers
- iii) Vernier caliper
- iv) Scribers
- v) Scribing block
- vi) Vernier height gauge
- vii) Centre punch
- viii) Surface plate
- ix) Micrometer screw gauge
- x) Angular measurement

#### 10.1.3T3 Workshop hand tools

- i) Vices
- ii) Files
- iii) Saws
- iv) Hammer
- v) Chisels
- vi) Snips
- vii) Tap and dies

#### **Practice**

#### 10.1.3P0 *Specific Objectives*

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

- a) use measuring instruments correctly
- b) identify and use marking out tools
- c) safely use various workshop cutting tools
- d) mark and carry out a given practical exercise
- e) maintain tools

- Content*
- 10.1.3P1 Ordinary measurement  
 i) Steel rules  
 ii) inside and outside caliper
- 10.1.3P2 Precision measurement  
 i) Vernier calipers  
 ii) Micrometers  
 iii) Angle measurements if use protectors  
 iv) Precautions in use of measuring
- 10.1.3P3 Marking out tools  
 i) Scriber  
 ii) Divider  
 iii) Centre punch surface plat  
 iv) Angle place  
 v) Vernier height gauge  
 vi) Protector v-block
- 10.1.3P4 Precautions in use of marking tools  
 i) Workshop cutting hand tools  
 ii) Chisels  
 iii) Hacksaw  
 iv) Punches  
 v) Files  
 vi) Precautions in the use of hand tools
- 10.1.3P5 Maintenance of tools

**10.1.3C Competence**

The trainee should have the ability to:

- Use measuring tools correctly
- Use various tools safely
- Carry out various metal fitting exercises

*Suggested Learning Resources*

- Work shop tools and equipment

**10.1.4 JOINING OF METALS**

**Theory**

10.1.4T1 *Specific Objectives*

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

- a) explain various methods of mechanical jointing of metals
- b) explain various methods of thermal joining of metals

*Content*

- 10.1.4T1 Mechanical joining of metals  
 i) Temporary removable joints  
 ii) Screw – types – threads – applications  
 iii) Bolts and nuts  
 iv) Studs and keys  
 v) Riveting  
 vi) Pop riveting  
 vii) Precautions
- 10.1.4T2 Thermal joining  
 i) Soldering  
 ii) Soft soldering  
 iii) Hard soldering  
 iv) Brazing  
 v) Oxy-acetylene welding  
 vi) Electric arc welding  
 vii) Necessary pre cautioning

**Practice**

10.1.4P1 *Specific Objectives*

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

- a) identify tools and equipment used in various mechanical joining of metals

- b) identify tools and equipment used in various thermal joining of metals
- c) join metals using appropriate methods

- iii) Observe quality control and safety
- iv) Carry out a given exercise correctly within a given time
- v) Maintain tools and equipment

*Content*

10.1.4P1 Equipment for Mechanical joining

- i) Fasteners screws, bolts and nuts
- ii) Self interlocking joints
- iii) Grooved seam
- iv) Folding seam
- v) Paned seam
- vi) Care of tools and equipment
- vii) Mechanical riveting
- viii) Types of rivets
- ix) Materials
- x) Size

10.1.4P2 Equipment for Thermal joining

- i) Soldering
- ii) Brazing
- iii) Arc welding
- iv) Sport welding
- v) Seam welding
- vi) Heat sources
- vii) Seam welding
- viii) Filler metal
- ix) Fluxes

10.1.4P3 Metal joining process

- i) Safety
- ii) Personal
- iii) Others
- iv) Tools and equipment

**10.1.4C Competence**

The trainee should have the ability to:

- i) Select the right tools for the right job
- ii) Use right procedures in metal joining

*Suggested Learning Resources*

- Soldering iron
- Soldering wire/rod
- Rivet grim and rivets
- Screws nuts and bolts
- Oxy – acetylene gas equipment
- Drilling machine
- Arc welding machine
- Blow lamp
- Films and posters

**10.1.5 WORKSHOP MACHINES AND APPLICATIONS**

**Theory**

10.1.5T0 *Specific Objectives*

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

- a) identify various types of workshop machines
- b) explain the operation of various workshop machines
- c) observe necessary safety precautions while using workshop machines

*Content*

10.1.5T1 Types of Workshop machines

- i) Drilling machine
- ii) Hand drills
- iii) Centre lathe machine
- iv) Shaping machine



10.1.5T2 v) Grinding machine  
Operation of different types of workshop machines

- i) Methods of work holding
- ii) Drilling
- iii) Turning
- iv) Facing

10.1.5T3 Safety precautions while using workshop machines

### Practice

10.1.5P0 *Specific Objectives*

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

- a) select the right tool for the right job
- b) perform given tasks using workshop machines
- c) demonstrate safe working habits
- d) maintain workshop machine

### Content

10.1.5P1 Identification of tools

- i) Drilling machine
- ii) Centre lathe
- iii) Pulling machine
- iv) Shaping machine
- v) Grinding machine

10.1.5P2 Operation of machines exercises

- i) Drilling
- ii) Facing
- iii) Turning
- iv) Knurling

10.1.5P3 Demonstrate safe working habit

10.1.5P4 Maintenance of workshop machines

### 10.1.5C Competence

The trainee should have the ability to:

- i) Selection of right tools
- ii) Perform given tasks safely and correctly
- iii) Operate given machines correctly

### *Suggested Learning Resources*

- Drilling machines
- Lathe machines
- Grinding machines
- Necessary tools
- Instructional sheets

## 10.1.6 SHEET METAL WORK

### Theory

10.1.6T0 *Specific Objectives*

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

- a) identify common sheet metals
- b) use sheet metal tools
- c) explain the process of sheet metal work
- d) explain edge treatment of joints in sheet metal work
- e) operate sheet metal fabrication machines

### Content

10.1.6T1 Identification of common sheet metals

- i) Galvanized sheet iron
- ii) Tin plate

10.1.6T2 Uses of tools

- i) Cutting tools
- ii) Forming tools
- iii) Marking out tools

10.1.6T3 Forming in sheet metal work

- i) Metal forming process

- ii) Testing squareness
- iii) Testing flatness

10.1.6T4 Edge treatment of joints

- i) Soldering
- ii) Forging
- iii) Filling
- iv) Binding

10.1.6T5 Sheet metal fabrication machines

- i) Shearing machines
- ii) Bending machines
- iii) Punching machines
- iv) Notching machine

**Practice**

10.1.6P0 *Specific Objectives*

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

- a) interpret drawings in sheet metal work
- b) estimate materials for sheet metal work
- c) identify sheet metal fabrication tools and machines
- d) carry out markings on a piece of sheet metal work
- e) assemble part of a given practical exercise on sheet metal
- f) demonstrate safety awareness in the use of sheet metal
- g) maintain tools and machines

*Content*

- 10.1.6P1 Interpretation of drawing
- 10.1.6P2 Material estimate from given drawing
- 10.1.6P3 Identification of tools

- i) Dividers
- ii) Punches
- iii) Surface plate
- iv) Angle plate
- v) Vernier height gauge
- vi) Protractor
- vii) V- block
- viii) Machines
- ix) Shearing machines
- x) Bending machines
- xi) Punching machines
- xii) Notching machines
- xiii) Brakes and roll forming machines

10.1.6P4 Marking out procedures

10.1.6P5 Sheet metal parts

- making and assembly

10.1.6P6 Observation of safety

10.1.6P7 Maintenance tools and equipment

**10.1.6C Competence**

The trainee should have the to:

- i) Fabricate a sheet metal project
- ii) Maintain tools and equipment

*Suggested Teaching/Learning Resources*

- Various workshop-machines and metal tools
- Folding , vices ( bench portable pipe vice)
- Pipe folding machines
- Shearing machines