

8.1.0 PHYSICAL SCIENCE

8.1.1 Introduction

This module unit aims at the fundamentals of Chemistry and Physics which form the basics for practical application in building and civil engineering works. It is also designed to equip the trainee with the basic principles of Chemistry and Physics applicable in building and civil engineering.

8.1.2 General Objectives

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

- apply the basic principles of chemistry and physics to practical areas in the field of building and civil engineering.
- observe safe working habits in the laboratory

8.1.3 Module Summary and Time Allocation – (66 Hours)

Code	Sub Module Units	Content	Time Hours		
			Theory	Pract	Total
8.1.01	Atomic Structure and Bonding	<ul style="list-style-type: none">• Description of Atomic Structure• Importance of Outermost Electrons in Chemical Bonding• Features of Chemical Bond• Bond Type	2	3	5
8.1.02	Mole Concept, Formulae and Chemical Reactions	<ul style="list-style-type: none">• Definitions of Terms• Chemical Equations• Oxidation/Reduction• Application in Redox Reactions• Role of Water in Ionization	2	3	5
8.1.03	Acids, Bases and Salts	<ul style="list-style-type: none">• Definition of Terms• Strength of Acids and Bases• Properties of Acids, Bases and Salts• Preparation of a Given	2	2	4

Code	Sub Module Units	Content	Time Hours		
			Thery	Pract	Total
		Salt			
8.1.04	Hardness of Water	<ul style="list-style-type: none"> • Meaning of Hard Water and Soft Water • Causes of Hardness an Water • Process of Softening Hard Water 	4	5	9
8.1.05	Polymers	<ul style="list-style-type: none"> • Definitions of Terms • Types of Polymers • Disposal of Polymers 	2	3	5
8.1.06	Nuclear Chemistry	<ul style="list-style-type: none"> • Meaning of Radio Activity • Nature of Radio Activity • Radio Activity Decay Service • Application of Radio ISO type • Non Destructive Testing 	2	4	6
8.1.07	Optics	<ul style="list-style-type: none"> • Nature of Light • Laws of Reflection • Laws of Refraction • Types of Mirrors • Dispersion of Light • Optical Instrument 	4	4	8
8.1.08	Sound	<ul style="list-style-type: none"> • Sources of Sound • Propagation of Sound • Production of Sound 	4	8	12
8.1.09	Mechanics	<ul style="list-style-type: none"> • Types of Forces • Varying • Uniformly Distributed • Concentrated • Movements 	6	6	12
Total			28	38	66

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			Theory	Pract	Total
8.1.04	Hardness of Water	Salt <ul style="list-style-type: none"> • Meaning of Hard Water and Soft Water • Causes of Hardness an Water • Process of Softening Hard Water 	4	5	9
8.1.05	Polymers	<ul style="list-style-type: none"> • Definitions of Terms • Types of Polymers • Disposal of Polymers 	2	3	5
8.1.06	Nuclear Chemistry	<ul style="list-style-type: none"> • Meaning of Radio Activity • Nature of Radio Activity • Radio Activity Decay Service • Application of Radio ISO type • Non Destructive Testing 	2	4	6
8.1.07	Optics	<ul style="list-style-type: none"> • Nature of Light • Laws of Reflection • Laws of Refraction • Types of Mirrors • Dispersion of Light • Optical Instrument 	4	4	8
8.1.08	Sound	<ul style="list-style-type: none"> • Sources of Sound • Propagation of Sound • Production of Sound 	4	8	12
8.1.09	Mechanics	<ul style="list-style-type: none"> • Types of Forces • Varying • Uniformly Distributed • Concentrated • Movements 	6	6	12
Total			28	38	66

8.1.01

ATOMIC STRUCTURE AND BONDING

Theory

8.1.01T0

Specific Objectives

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

- a) describe the structure of an atom
- b) explain the importance of outermost electrons in chemical bonding
- c) outline the main features of chemical bonds
- d) explain the effect of bond type and structure on the physical properties of common construction materials

8.1.01C

Competence

The trainee should have the ability to:

- i) apply the atomic structure and bonding in nuclear chemistry
- ii) relate bond type and structure to properties of common construction materials

8.1.01T1

Content

Description of structure of an atom

8.1.01T2

Importance of outermost electrons in chemical bonding

8.1.01T3

Main features of chemical bonds

- ionic
- covalent
- dative
- hydrogen

8.1.01T4

Effect of bond type and structure on physical properties of common construction materials

Practice

8.1.01P0

Specific Objective

By the end of the sub-module unit, the trainee should be able to analyse the effect of bond type and structure on the physical properties of common construction materials

8.1.01P1

Content

Bond type and structure on physical properties of common construction materials

8.1.02 MOLE CONCEPT
FORMULAE AND
CHEMICAL
REACTIONS

Theory

- 8.1.02T0 *Specific Objectives*
By the end of the sub-
module unit, the trainee
should be able to:
- define the terms
mole, molar solution
and standard
solution
 - write balanced
chemical equations
 - explain the process
of oxidation and
reduction
 - apply redox
reactions to
corrosion/reduction
of ores
 - explain the role of
 H_2O in ionization

- 8.1.02C *Competence*
The trainee should have
the ability to:
- explain the process
of oxidation/
reduction
 - apply redox
reactions to
corrosion/reduction
of ores
 - perform experiment
on electrolysis of
water

- Content*
- 8.1.02T1 Definition of
terms
- 8.1.02T2 Chemical
equations
- 8.1.02T3 Oxidation/
Reduction
- 8.1.02T4 Application of
redox reactions
- 8.1.02T5 The role of H_2O
in ionization

Practice

- 8.1.02P0 *Specific Objectives*
By the end of the sub-
module unit, the trainee
should be able to:
- carry out the
process of oxidation
and reduction
 - apply redox
reactions to
corrosion/reduction
of ores
 - analyse the role of
 H_2O in ionization

- Content*
- 8.1.02P1 Oxidation/
Reduction
- 8.1.02P2 Application of
redox reactions
- 8.1.02P3 The role of H_2O
in ionization

8.1.03 ACIDS, BASES AND SALTS

Practice

Theory

8.1.03P0

Specific Objectives

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

- a) determine the strength of acids and bases
- b) carry out the preparation of a given salt

8.1.03T0

Specific Objectives

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

- a) define the terms acid, base and salt and pH
- b) explain the strength of acids and bases
- c) explain the properties of
 - acids
 - bases
 - salts
- d) describe the preparation of a given salt

Content

8.1.03P1

Strength of acids and bases

8.1.03P1

Preparation of a given salt

8.1.03C

Competence

The trainee should have the ability to:

- i) determine the degree of acidity/basicity of a given substance
- ii) perform acid/base titrations in the laboratory

8.1.04

HARDNESS OF WATER

Theory

8.1.04T0

Specific Objectives

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

- a) explain the terms hard water and soft water
- b) outline the causes of temporary and permanent hardness
- c) explain the process of softening hard water

8.1.03T1

Content
Definition of terms

8.1.03T2

Strength of acids and Bases

8.1.03T3

Properties of Acids, Bases and salts

8.1.03T4

Preparation of a given salt

8.1.04C

Competence

The trainee should have the ability to:

- i) differentiate between hard and soft water
- ii) identify the causes of temporary and permanent hardness of water
- iii) soften hard water

- c) differentiate between natural and synthetic polymers
- d) explain disposal of polymers

8.1.05C

Competence

The trainee should have the ability to:

- i) distinguish between natural and synthetic polymers
- ii) observe safe disposal methods

- 8.1.04T1 *Content*
Meaning of hard water and soft water
- 8.1.04T2 Causes of hardness in water
- 8.1.04T3 Process of softening hard water

8.1.05T1

Content

Definition of terms

- monomers
- polymers
- polymerization

- 8.1.04P0 *Practice*
Specific Objective
By the end of the sub-module unit, the trainee should be able to soften hard water

8.1.05T2

Types of polymers

- natural
- synthetic

- 8.1.04P1 *Content*
Process of softening hard water

8.1.05T3

Disposal of polymers

Practice

8.1.05 **POLYMERS**

8.1.05P0

Specific Objectives

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

- a) differentiate between natural and synthetic polymers
- b) observe safe disposal of polymers

Theory

- 8.1.05T0 *Specific Objectives*
By the end of the topic sub-module unit, the trainee should be able to:
- a) define terms used in polymerization
 - b) explain the types of polymerization

8.1.05P1

Content

Types of polymers

- natural
- synthetic

8.1.05P2

Disposal of polymers

NUCLEAR CHEMISTRY

Practice

Theory

Specific Objectives

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

- define radioactivity
- explain the nature of radioactivity
- outline a given radioactive decay services
- state the application of radio isotopes
- apply the principles of radio activity in non-destructive testing

Competence

The trainee should have the ability to apply the principles of radioactivity in non-destructive testing

Content

Meaning of radioactivity

Nature of radioactivity

Radioactivity decay services

Application of radio isotopes

Apply the principles of radioactivity in non-destructive testing

8.1.06P0

Specific Objective

By the end of the sub-module unit, the trainee should be able to apply the principles of radio activity in non-destructive testing

8.1.06P1

Content

Apply the principles of radioactivity in non-destructive testing

8.1.07

OPTICS

Theory

8.1.07T0

Specific Objectives

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

- describe the nature of light
- state the laws of reflection and refraction
- describe types of mirrors and images formed
- describe dispersion of light
- operate optical instruments

8.1.07C

Competence

The trainee should have the ability to use common optical instruments

8.1.07T1	<p><i>Content</i> Nature of light Laws of reflection Laws of refraction Types of mirrors - plane - curved Dispersion of light - fluids - prisms - rectangular blocks Optical instruments - cameras - projector - magnifying glass</p>	8.1.08C	<p>c) explain the production of sound</p> <p><i>Competence</i> The trainee should be able to demonstrate the ability to regulate sound on the site</p>
8.1.07T2		8.1.08T1	<p><i>Content</i> Sources of sound Propagation of sound - air - liquids - sounds Production of sound - pitch - loudness - intensity</p>
8.1.07T3		8.1.08T2	
8.1.07T4		8.1.08T3	
8.1.07T5			
8.1.07T6			
	Practice		
8.1.07P0	<p><i>Specific Objective</i> By the end of the sub-module unit, the trainee should be able to operate optical instruments</p>	8.1.08P0	<p><i>Practice</i> <i>Specific Objectives</i> By the end of the sub-module unit, the trainee should be able to: a) describe how sound is propagated b) analyse the production of sound</p>
8.1.07P1	<p><i>Content</i> Optical instruments - cameras - projector - magnifying glass</p>		
8.1.08	SOUND	8.1.08P1	<p><i>Content</i> Propagation of sound - air - liquids - sounds Production of sound - pitch - loudness - intensity</p>
	Theory		
8.1.08T0	<p><i>Specific Objectives</i> By the end of the sub-module unit, the trainee should be able to: a) describe the sources of sound b) describe how sound is propagated</p>	8.1.08P1	

MECHANICS

Theory

Specific Objectives

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

- describe type of loads
- define moments
- apply the principle of moments
- apply principles of circular motion

Competence

The trainee should have the ability to:

- distinguish the type of loads
- apply principle of moments
- apply principles of circular motion

Content

Types of loads

- Varying
- Uniformly distributed
- Concentrated

Moments

Principle of moments

Circular motion

Practice

Specific Objectives

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

- apply the principle of moments
- apply principles of circular motion

Content

Principle of moments

Principles of circular motion

Suggested

Teaching/Learning Methods

- Discussion
- Demonstration
- Field visits
- Practical exercises

Suggested Learning Resources

- Modern Inorganic Chemistry by F. Liptrot
- Charts
- Internet
- Newspapers and magazines

Suggested Assessment Methods

- Oral tests
- Written tests

Tools and Equipment

- Plane mirrors
- Curved mirrors
- Prisms
- Rectangular blocks
- Camera projectors
- Magnifying glass