

8.1.0 ELECTRICAL PRINCIPLES & INSTRUMENTATION

8.1.1 Introduction

Most machines in mechanical engineering which use electricity as a source of power are operated using electrical and electronic control systems. This module unit is designed to equip the trainee with the necessary knowledge, skills, attitudes and competencies in electrical electronic and instruments to enable the trainee operate, maintain and repair mechatronic systems. The module unit is also meant to prepare the trainee for other module units in this course and for further training.

The unit has both theoretical and practical aspects and thus theory and practical tests are recommended as the main modes of assessment.

8.1.2 General Objectives

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

- acquire knowledge of the general working principles of various electrical, electronic components and instruments
- select and use special electrical and electronics tools and equipment
- diagnose, service, maintain and repair faults in electrical machines, electronic systems and instruments

8.1.3 Module Unit Summary and Time Allocation

Code	Sub Module Unit	Content	Time (Hrs)		
			Theory	Practice	Total
8.1.01	Basic Electrical Principles	<ul style="list-style-type: none">Electrical quantities and their S.I. unitsElectrical circuitsElectrical lawsSolution to electrical problems	6	4	10
8.1.02	Magnetism and Electro-magnetism	<ul style="list-style-type: none">Types of magnetsMagnetic circuitsElectro-magnetic induction	10	4	14
8.1.03	AC/DC Motors and Generators	<ul style="list-style-type: none">Construction of DC machinesPrinciple of operation of DC machinesPower factor in AC circuits	8	4	12

8.1.04	Electronics Components	<ul style="list-style-type: none"> • Construction features of electronics components • Operation of electronics components • Application of electronics components 	6	4	10
8.1.05	Instrumentation Systems	<ul style="list-style-type: none"> • Definition of terms in instrumentation • Identification of various instrumentation components • Instrumentation systems 	8	-	8
8.1.06	Display & Recording	<ul style="list-style-type: none"> • Principles of recording • Application of display devices 	8	4	12
Total Time			36	30	66

8.1.01 BASIC ELECTRICAL PRINCIPLES

Theory

8.1.01T Specific Objectives

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

- state the basic electrical quantities and their S.I units
- explain the components of an electrical circuit
- explain basic electrical laws
- solve problems using basic electrical laws

8.1.01C Competence

The trainee should have the ability to:

- connect various simple electric circuits

- perform measurement of electrical quantities

Content

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| 8.1.01T1 | Electrical quantities and their S.I units |
| | <ol style="list-style-type: none"> voltage current resistance power |
| 8.1.01T2 | Electric circuits |
| | <ol style="list-style-type: none"> simple circuits resistors in parallel resistors in series resistors in parallel and series switches and protection circuits earthing - types of earthing |
| 8.1.01T3 | Electrical laws |
| | <ol style="list-style-type: none"> Ohms law Kirchhoff's law |

8.1.01T4 Solution to electrical problems

Practice

8.1.01P *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:

- a) measure electrical quantities
- b) draw electrical circuits
- c) measurement of resistance by use of potentiometer

*Suggested Teaching/
Learning Resources*

- drawing and manuals
- electrical circuits charts
- voltmeter
- multimeter
- resistors
- conductors
- batteries
- switches
- circuit boards

8.1.02 MAGNETISM AND ELECTRO-MAGNETISM

Theory

8.1.02T *Specific Objectives*
By the end of this sub-module unit, the trainee should be able to:

- a) state types of magnets
- b) describe magnetic circuits

c) explain the principle of electromagnetic induction

8.1.02C Competence

The trainee should have the ability to explain the ability to use electro-magnetism in Engineering

Content

8.1.02T1 Types of magnets

- i) temporary
- ii) permanents

8.1.02T2 Magnetic circuits

- i) laws of magnetism
- ii) inductance

8.1.02T3 Principle of electromagnetic induction

Practice

8.1.02P *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:

- a) demonstrate the principle of electromagnetic induction
- b) verify the existence of magnetic field

*Suggested Teaching/
Learning Resources*

- metal/iron fillings
- bar magnets
- conductors

- bulb
- multimeter

8.1.03 AC/DC MOTORS AND GENERATORS

Theory

- 8.1.03T *Specific Objectives*
By the end of this sub-module unit, the trainee should be able to:
- a) explain the principle of operation of DC machines
 - b) explain the principle of operation of AC machines
 - c) explain the power factor in AC circuits

- 8.1.03C **Competence**
The trainee should have the ability to:
- i) maintain DC/AC machines
 - ii) operate AC/DC machines

- 8.1.03T1 *Content*
Operation of DC machines
- 8.1.03T2 Operation of AC machines
- 8.1.03T3 Power factor in AC circuits
- Definition
 - Power factor correction

Practice

- 8.1.03P *Specific objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) identify components of DC machines
 - b) identify components of AC machines

Suggested Teaching/ Learning Resources

- manuals
- charts
- DC motors
- AC motors
- Multimeter
- AC circuit trainer kit
- Power supply

8.1.04 ELECTRONIC COMPONENTS

Theory

- 8.1.04T *Specific Objectives*
By the end of this sub-module unit, the trainee should be able to:
- a) explain the construction of features of various electronic components
 - b) describe the operation of various electronics components
 - c) state the application of various electronic components

8.1.04C	<p>Competence The trainee should have the ability to:</p> <ul style="list-style-type: none"> i) select and use various electronic components ii) test electronic components iii) determine component values and ratings 	<p><i>Suggested Teaching/ Learning Resources</i></p> <ul style="list-style-type: none"> - electronic components trainer kit - power supply - multimeter
8.1.04T1	<p><i>Content</i> Construction features of electronic components</p> <ul style="list-style-type: none"> i) resistors ii) capacitors iii) inductors iv) diodes v) transistors 	<p>8.1.05 INSTRUMENTATION SYSTEMS</p>
8.1.04T2	<p>Operation of Electronic components</p>	<p>Theory</p>
8.1.04T3	<p>Application of electronic components</p>	<p>8.1.05T <i>Specific Objectives</i> By the end of this sub-module unit, the trainee should be able to:</p> <ul style="list-style-type: none"> a) Define terms in instrumentation system b) Identify various instrumentation components c) Describe types of instrumentation systems
	<p>Practice</p>	<p>8.1.05C Competence The trainee should have the ability to identify various instrumentation components.</p>
8.1.04P	<p><i>Specific objectives</i> By the end of the sub-module unit, the trainee should be able to:</p> <ul style="list-style-type: none"> a) identify the various electronics components b) test various electronic components 	<p><i>Content</i> 8.1.05T1 Definition of terms in instrumentation systems</p> <ul style="list-style-type: none"> i) measurement ii) instrument iii) instrumentation system

<p>8.1.05T2 Components identification</p> <ul style="list-style-type: none"> i) transducer ii) signal processing iii) signal path iv) display/recorder <p>8.1.05T3 Types of instrumentation system</p> <ul style="list-style-type: none"> i) analogue ii) digital iii) hybrid <p><i>Suggested Teaching/Learning Resources</i></p> <ul style="list-style-type: none"> - charts - signal generator - instruments - manuals 	<p><i>Content</i></p> <p>8.1.06T1 Principles of recording</p> <ul style="list-style-type: none"> i) magnetic ii) optical iii) analogue iv) semi-conductors v) charged coupled devices (CCD) <p>8.1.06T2 Application of display devices</p> <ul style="list-style-type: none"> i) light emitting diode (LED) ii) liquid crystal display (LCD) iii) nixie tubes iv) video display unit (VDU's)
<p>8.1.06 DISPLAY AND RECORDING</p> <p>Theory</p> <p>8.1.06T <i>Specific Objectives</i></p> <p>By the end of the sub-module unit, the trainee should be able to:-</p> <ul style="list-style-type: none"> a) describe principles of recording b) explain application of display devices <p>8.1.06C Competence</p> <p>The trainee should have ability to identify different types of recording devices.</p>	<p>Practice</p> <p>8.1.06P <i>Specific objectives</i></p> <p>By the end of the sub-module unit, the trainee should be able to use recorders to record data.</p> <p><i>Content</i></p> <p>8.1.06P1 Use of recorders</p> <p><i>Suggested Teaching/Learning Resources</i></p> <ul style="list-style-type: none"> - LEDs - VDUs - Chart recorders - Manuals