15.1.0 ANALOGUE ELECTRONICS I

15.1.01 Introduction

Analogue electronics is a study that deals with electronic systems with a continuously variable signal. This module unit is intended to impart knowledge, skills and attitudes required to enable the trainee understand the principles of operations of various electrical circuits, equipment and devices in the industries. This unit forms a foundation for Analogue Electronics II in Module II.

15.1.02 General Objectives

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

a) Understand the operation of analogue electronic devices
b) Apply analogue electronic components in the construction of power supply units and other electronic devices
c) Observe safety when using analogue electronic components and devices

15.1.1 Module Unit Summary and Time Allocation

Analogue Electronics I

Code	Module Unit	Content	Time Hrs
15.1.1	Atomic Theory of matter	• Atomic structure • Energy levels	8
15.1.2	Thermionic Emission	• Principles of the CRT • Advantages and limitations of valves • Motions of electrons • Principles of the CRO • Applications of thermionic emission	10
15.1.3	Semi conductor theory	• Intrinsic semi conductor. • Effect of temperature on intrinsic semiconductor • Doping p and n types • Formation of extrinsic	8

		semiconductor	
15.1.4	Semi-conductor diodes	• PN junction diode • Forward and reverse bias of pn junction diodes • Applications of pn junction diodes	10
15.1.5	Bipolar Junction Transistors	• Operation of NPN and PNP • Characteristics • Biasing methods • Determination of gains using Dc/ac load-lines	8
15.1.6	Field Effect Transistor	• Operation of field effect transistors • Biasing methods • Determination of gains using dc/ac load-lines	10
15.1.7	Power supply units	• Transformation • Rectification • Filtering • Stabilization • Regulation • Voltage multiplication • Power conversion	12
Total Time			**66**

15.1.1 ATOMIC THEORY OF MATTER

Theory

15.1.1T0 *Specific Objectives*

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

a) explain atomic structure
b) explain energy level of an Atom

Content

15.1.1T1 Explanation of atomic structure
- i) The atom
- ii) Rutherford's atomic model
- iii) Plank's quantum Theory of radiation
- iv) Bohr's model

15.1.1T2 Explain the energy levels
- i) Energy level diagram
- ii) Collision of electrons and atoms
- iii) Photons of light
- iv) Spectral lines
- v) Photo ionization
- vi) Conduction band
- vii) Valence band
- viii) Forbidden gap

15.1.2 THERMIONIC EMISSION

Theory

15.1.2T0 *Specific Objectives*

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

a) explain principles of thermionic emission
b) state the advantages and limitations of valves in electronic industry
c) explain the motion of electrons in a magnetic and electrostatic field
d) describe the construction and operation of a Cathode Ray Tube (CRT)
e) describe the construction and operation of a Cathode Ray Oscilloscope (CRO)
f) explain the application of thermionic emission

Content

15.1.2T1 Principles of thermionic emission
- i) Work function
- ii) Space charge
- iii) Direct and indirect heating
- iv) Electron emitting materials

15.1.2T2 Applications and limitations of valves

15.1.2T3 Motion of electrons in magnetic and electrostatic fields
- i) Force
- ii) Deflection in transverse field
- iii) Magnetic field deflection
- iv) Electrostatic field deflection
- v) Electron velocity
- vi) Deflection of an electron beam

15.1.2T4 Cathode Ray Tube
- i) Construction
- ii) Operation
- iii) Application

15.1.2T5 Cathode Ray Oscilloscope

i) Describe the construction by block diagram
ii) Describe the operation

15.1.2T6 Applications

Practice

15.1.2P0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to:
a) operate a cathode-ray oscilloscope (CRO)
b) take measurements using a CRO

Content
15.1.2P1 Operating a CRO
15.1.2P2 Taking measurements using a CRO

15.1.2C Competence
The trainee should have the ability to:
i) Operate a CRO
ii) Take measurements using a CRO

Learning Resources
i) Cathode-ray oscilloscope
ii) Signal generators
iii) Probes

15.1.3 SEMI CONDUCTOR THEORY

Theory

15.1.3T0 *Specific Objectives*
By the end of the sub module unit the trainee should able to:
a) explain intrinsic semiconductor
b) explain effect of temperature on intrinsic semiconductor
c) describe doping
d) describe formation of extrinsic semiconductor

Content
15.1.3T1 Bond in Intrinsic semi conductors
i) Ge Si
ii) Covalent bonding
15.1.3T2 Temperature on intrinsic semi conductor materials
15.1.3T3 Doping
15.1.3T4 Formation of extrinsic semi conductor
iv) p type
v) n type

Practice

15.1.3P0 *Specific Objectives*
By the end of the sub module unit, the trainee should be able to verify the effect of temperature on a diode performance

Content
15.1.3P1 Verification of the effect of temperature on diode

15.1.3C Competence
The trainee should have the ability to:
i) Verify the effect of temperature on diodes
ii) Use a diode in electronic circuits

Suggested teaching/Learning Activities
- Demonstration

- Note taking
- Observation
- Practical exercise

Suggested teaching/Learning Resources

i) Various types of diodes
ii) Electronic tool kit
iii) Power supply

Suggested Evaluation Methods

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

15.1.4 SEMICONDUCTOR DIODE

Theory

15.1.4T0 *Specific Objectives*

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

a) describe formation of PN junction
b) explain forward and reverse bias of PN junction
c) explain applications of semiconductor diodes

Content

15.1.4T1 Formation of an PN junction diode.
i) Diffusion
ii) Depletion layer
iii) Barrier potential

15.1.4T2 Forward and reverse mode of operation of PN junction diode.
i) Drift
ii) Forward characteristics
iii) Reverse characteristics
iv) Zener Avalanche effect

15.1.4T3 Application of semiconductor diodes
i) Power diodes
ii) signal diodes

Practice

15.1.4P0 *Specific Objectives*

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

a) identify the diode terminals
b) determine diode characteristics

Content

15.1.4P1 Identifying diode terminals

15.1.4P2 Determining diode characteristics

15.1.4C Competence

The trainee should have the ability to:

i) Identify diode terminals
ii) Determine diode characteristics

Suggested teaching/Learning Activities

- Demonstration
- Note taking
- Observation
- Practical exercise

Learning Resources

i) Assorted semi conductor diodes
ii) DC power supply
iii) Multimeters
iv) Graph paper
v) X-ray plotter

Suggested Evaluation Methods

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

15.1.5 BIPOLAR JUNCTION TRANSISTORS

Theory

15.1.5T0 *Specific Objectives*

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

a) describe the construction and operation of a Bipolar Junction Transistors (BJT)
b) explain the characteristics of Bipolar Junction Transistor
c) describe the biasing methods
d) determine gains using DC load lines

Content

15.1.5T1 Construction and operation of BJTs
- i) NPN
- ii) PNP

15.1.5T2 Static characteristics of BJTs
- i) Input
- ii) Output
- iii) Transfer

15.1.5T3 Transistor biasing methods
- i) Base bias
- ii) Emitter bias
- iii) Collector base feedback bias
- iv) Potential divider bias

15.1.5T4 DC load-lines
- DC load-line
- i) Gain estimates
- ii) Current, voltage and power gain
- iii) Maximum power curve.

Practice

15.1.5P0 *Specific Objectives*

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

a) identify the type of transistors
b) determine static transistor characteristics
c) bias a transistor amplifier
d) construct dc loadlines

Content

15.1.5P1 Identifying types of transistors

15.1.5P2 Determining static characteristics of transistors

15.1.5P3 Biasing transistor amplifier

15.1.5P4 Constructing dc loadlines

15.1. C Competence

The trainee should have the ability to:

i) Construct a single stage transistor amplifier
ii) Test a single stage transistor amplifier

Suggested teaching/Learning Activities

- Illustration
- Demonstration
- Note taking

Learning Resources

i) Power supplies
ii) Assorted transistors
iii) Breadboard

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

15.1.5 BIPOLAR JUNCTION TRANSISTORS

Theory

15.1.5T0 *Specific Objectives*

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

a) describe the construction and operation of a Bipolar Junction Transistors (BJT)
b) explain the characteristics of Bipolar Junction Transistor
c) describe the biasing methods
d) determine gains using DC load lines

Content

15.1.5T1 Construction and operation of BJTs
- i) NPN
- ii) PNP

15.1.5T2 Static characteristics of BJTs
- i) Input
- ii) Output
- iii) Transfer

15.1.5T3 Transistor biasing methods
- i) Base bias
- ii) Emitter bias
- iii) Collector base feedback bias
- iv) Potential divider bias

15.1.5T4 DC load-lines
- i) Gain estimates
- ii) Current, voltage and power gain
- iii) Maximum power curve.

Practice

15.1.5P0 *Specific Objectives*

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

a) identify the type of transistors
b) determine static transistor characteristics
c) bias a transistor amplifier
d) construct dc loadlines

Content

15.1.5P1 Identifying types of transistors

15.1.5P2 Determining static characteristics of transistors

15.1.5P3 Biasing transistor amplifier

15.1.5P4 Constructing dc loadlines

15.1. C Competence

The trainee should have the ability to:
- i) Construct a single stage transistor amplifier
- ii) Test a single stage transistor amplifier

Suggested teaching/Learning Activities
- Illustration
- Demonstration
- Note taking

Learning Resources
- i) Power supplies
- ii) Assorted transistors
- iii) Breadboard

iv) Connecting leads
v) Multimeters
vi) X-Y plotter
vii) Assorted resistors

- Observation
- Practical exercise
- Calculations
- Project work
- Role play
- Visits to industries

Suggested Evaluation Methods

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

15.1.6 FIELD EFFECT TRANSISTORS

Theory

15.1.6T0 *Specific Objectives*

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

a) explain the characteristics of field effect transistor
b) describe the biasing methods
c) determine gains using dc and ac load-lines

Content

15.1.6T1 Construction and operation of FETs

i) Static characteristics of fets
ii) Jfets
iii) Mosfets
iv) Input
v) Output
vi) Transfer

15.1.6T2 FETs biasing methods

i) Gate bias
ii) Source bias
iii) Drain base feedback bias
iv) Potential divider bias

15.1.6T3 DC load-lines

i) DC Load-line
ii) Estimation gain (current, voltage and power)
iii) Maximum power curve.

Practice

15.1.6P0 *Specific Objectives*

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

a) identify the types of FETs
b) determine static FET characteristics
c) bias a FET
d) construct dc loadline

Content

15.1.6P1 Identifying types of FETs
15.1.6P2 Determination static characteristic of FETs
15.1.6P3 Biasing a FET amplifier
15.1.6P4 Construction of dc loadlines

15.1.6C Competence

The trainee should have the ability to:

i) Construct a single stage FET amplifier
ii) Test a single stage FET amplifier

Suggested teaching/Learning Activities

- Demonstration
- Note taking
- Observation
- Practical exercise

Suggested teaching/Learning Resources

i) Field effect transistors
ii) Power supply
iii) Electronic tools
iv) Electrical measuring instruments

Suggested Evaluation Methods

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

15.1.7 POWER SUPPLIES

Theory

15.1.7T1 *Specific Objectives*

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

a) describe block diagram of power supply
b) explain principles rectification
c) explain smoothing and filtering
d) explain power regulation/stabilizer methods
e) describe voltage multiplier methods
f) describe methods of power conversion

Content

15.1.7T1 Description of the block diagram of power supply
i) Transformation
ii) Rectification
iii) Filters
iv) Regulator

15.1.7T2 Explanation of principles rectification
i) Half wave
ii) Full wave bi-phase
iii) Bridge

15.1.7T3 Explanation filteration/smoothing
i) Capacitor filter
ii) Inductive filtering

15.1.7T4 Explanation power regulation/stabilizer methods
i) Zener diode regulator
ii) Linear regulators
iii) Switched regulators

15.1.7T5 Description of voltage multiplier methods
i) Doubler
ii) Tripler
iii) Cockroft walton

15.1.7T6 Description of methods of power conversion
i) Dc to ac
ii) Dc to dc

Practice

15.1.7P0 *Specific Objectives*

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

a) Construct a power supply unit
b) Test a power supply unit

Content

15.1.7P1 Construction of power supply units

15.1.7P2 Testing a power supply unit

15.1.7C Competence

The trainee should have the ability to: construct and test a power supply unit

Suggested teaching/Learning Activities

- Demonstration
- Note taking
- Observation

- Practical exercise

Teaching/Learning Resources

i) Step-down transformer
ii) Rectifier diodes
iii) Smoothing capacitor
iv) Zener diode regulations
v) Transistor regulations
vi) IC regulators
vii) Potentiometers
viii) Assorted resistors
ix) Multimeters
x) CRP
xi) RF bypass capacitors

Suggested Evaluation Methods

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