

18.2.0 ANALOGUE ELECTRONICS II

18.2.01 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.

Trainees will appreciate and apply the knowledge and skills learned in Analogue Electronics I of module I.

18.2.02 General Objectives

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

- a) Understand the characteristics of special semi-conductor devices
- b) Understand the operation of electronic circuits
- c) Apply semi-conductor devices

18.2.03 Module Unit Summary and Time Allocation

Analogue Electronics II

Code	Module Unit	Content	Time Hrs
18.2.1	Special Semi Conductor Devices	<ul style="list-style-type: none">• Principles of operation• Applications of special semiconductor devices	12
18.2.2	Amplifiers	<ul style="list-style-type: none">• RC coupled amplifiers• Analyses of linear amplifiers• Amplifier gain• Power amplifier• Tuned amplifiers• Wideband amplifiers• Amplifier distortion	16
18.2.3	Operational Amplifiers (Op-Amp)	<ul style="list-style-type: none">• Direct Coupled amplifiers• Differential amplifiers• OP-amp characteristics• OP-amp circuits	16
18.2.4	Feedback	<ul style="list-style-type: none">• Feedback principle• Feedback equations• Effects of negative feedback• Feedback connections	10
18.2.5	Sinusoidal Oscillators	<ul style="list-style-type: none">• Concept of oscillators• Oscillation requirements	10

		<ul style="list-style-type: none"> • Oscillator circuits 	
18.2.6	Wave Shaping and Pulse Generating Circuits	<ul style="list-style-type: none"> • Wave shaping • Pulse generation 	12
18.2.7	Opto-Electronics	<ul style="list-style-type: none"> • Theory of opto electronics • Lasers and masers • Properties and drive requirements • Photo devices • Applications 	12
Total Time			88

18.2.1 SPECIAL SEMI CONDUCTOR DEVICES

Theory

- 18.2.1T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) explain principles of semi conductor devices
 - b) state the application of semi conductor devices

Content

- 18.2.1T1 Principles of semi conductor devices
- i) Varactor diode
 - ii) UJT
 - iii) Programmable UJT
 - iv) Silicon controlled rectifiers (SCRS)
 - v) Silicon Controlled Switch (SCS)
 - vi) Diac
 - vii) Triac
- 18.2.1T2 Application of semi conductor devices

Practice

- 18.2.1P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) identify device terminals
 - b) verify device characteristics

Content

- 18.2.1P1 Identification of terminals

- 18.2.1P2 Verification of characteristics

18.2.1C Competence

The trainee should have the ability to: connect and test a special semi conductor device

Suggested teaching/Learning Activities

- Illustrations
- Demonstration
- Note taking
- Observation
- Practical exercise

Suggested Teaching/Learning Resources

- i) Various special semi conductor devices
- ii) Breadboard
- iii) Circuit board
- iv) Power supply
- v) Data/catalogue books
- vi) Internet

Suggested Evaluation Methods

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

18.2.2 AMPLIFIERS

Theory

- 18.2.2T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) explain the performance of RC coupled amplifiers

- b) analyze the frequency response of linear amplifiers
- c) derive the gain of an amplifier
- d) describe the operation of power amplifiers
- e) describe the operation of tuned amplifiers
- f) describe the operation of wideband amplifiers
- g) explain distortion in amplifiers

Content

- 18.2.2T1 RC coupled amplifiers
 - i) Biasing
 - ii) Stability
 - iii) Operating Conditions
- 18.2.2T2 Frequency response
 - i) Mid-band frequency
 - ii) High frequency
- 18.2.2T3 Gain of amplifiers
 - i) Graphical methods
 - ii) H-parameter analysis
- 18.2.2T4 Power amplifiers
 - i) Classes
 - ii) Efficiency
 - iii) Matching
 - iv) Push-pull
- 18.2.2T5 Tuned amplifiers
 - i) Tuned circuits
 - ii) Response curves
 - iii) Single tuned
 - iv) Double tuned
 - v) Stagger tuned
- 18.2.2T6 Wide band amplifiers
 - i) Common base
 - ii) Cascade
 - iii) Frequency compensation
 - iv) Applications
- 18.2.2T7 Distortion in amplifiers
 - i) Amplitude distortion
 - ii) Harmonic distortion

- iii) Frequency distortion
- iv) Phase distortion
- v) Non-linear distortion

Practice

18.2.2P0 *Specific Objectives*

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

- a) construct amplifiers
- b) verify amplifier performance

Content

- 18.2.2P1 Construction of amplifiers
- 18.2.2P2 Verification of permanence of amplifiers

18.2.2C **Competence**

The trainee should have the ability to: ability to construct and verify the performance of an amplifier

Suggested teaching/Learning Activities

- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise

Suggested teaching/Learning Resources

- i) Assorted electronic components
- ii) Power supply
- iii) Breadboard/circuit board
- iv) Connecting leads /wire
- v) Oscilloscope
- vi) Signal generators
- vii) Multimeter

Suggested Evaluation Methods

- Oral tests

- Timed written tests
- Assignments
- Timed practical tests
- Project
- Project presentation

18.2.3 OPERATIONAL AMPLIFIERS

Theory

18.2.3T0 *Specific Objectives*

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

- a) describe operation of direct coupled amplifiers
- b) explain the operation of differential amplifier
- c) state characteristics of operational amplifiers (Op-amps)
- d) analyse various operational amplifier circuits

Content

18.2.3T1 Direct coupled amplifiers circuit

- limitations

18.2.3T2 Differential amplifier

- i) Common Mode
- ii) Differential Mode
- iii) Common Mode Rejection Ratio (CMRR)

18.2.3T3 Characteristics of Op-amps

- i) Input resistance
- ii) Output resistance
- iii) Voltage gain
- iv) Bandwidth
- v) Response time

18.2.3T4 Analysis of Op-amp circuits

- i) Inverting and non-inverting amplifier
- ii) Subtractor
- iii) Adder
- iv) Differentiator
- v) Integrator
- vi) Filters
- vii) Oscillators
- viii) Comparators

Practice

18.2.3P0 *Specific Objectives*

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

- a) assemble and operate op-amp circuits
- b) test op-amp circuits

Content

18.2.3P1 Assembling and operating op-amp circuits

18.2.3P2 Testing of op-amp circuits

18.2.3C Competence

The trainee should have the ability to:

- i) Assemble and operate op-amp circuits
- ii) Test op-amp circuits

Suggested teaching/Learning

Resources

- Op-amp IC
- Circuit/bread board
- Power supply
- Oscilloscope
- Function generator
- Multimeter

Suggested teaching/Learning

Activities

- Illustration
- Demonstration

- Note taking
- Observation
- Practical exercise
- Calculations
- Project work

- ii) Voltage shunt
- iii) Current shunt
- iv) Practical amplifier circuits

Suggested Evaluation Methods

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

18.2.4 FEEDBACK

Theory

18.2.4T0 *Specific Objectives*

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

- a) explain principles of positive and negative feedback
- b) derive feedback equations
- c) explain effects of negative feedback on amplifier performance
- d) describe various feedback connections

Content

18.2.4T1 Feedback principles

18.2.4T2 Feedback equations

18.2.4T3 Effects of negative

i) Feedback

ii) Gain

iii) Stability

iv) Noise and distortions

v) Bandwidth

vi) Input and output impedances

18.2.4T4 Feedback.

i) Connections

PRACTICE

18.2.4P0 *Specific Objectives*

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

- a) verify the performance of negative feedback amplifiers
- b) construct negative feedback amplifiers

Content

18.2.4P1 Verify performance of negative feedback amplifiers

18.2.4P2 Construct negative feedback amplifiers

18.2.4C **Competence**

The trainee should have the ability to:

- i) Construct feedback amplifiers
- ii) Verify performance of feedback amplifiers

Suggested teaching/Learning Resources

- Assorted electronic components
- Power supply
- Circuit/bread board
- Oscilloscope
- Signal generators
- Multimeter
- Electronic toolkit

Suggested teaching/Learning Activities

- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Calculations
- Project work

- iii) Colpits
- iv) Hartley
- v) Crystal
- vi) Blocking
- vii) Derivation of frequency of oscillation

Practice

Suggested Evaluation Methods

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

- 18.2.5P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) verify performance of oscillator circuits
 - b) construct oscillator circuits

18.2.5 SINUSOIDAL OSCILLATORS

Theory

- 18.2.5T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) explain the concept of oscillations
 - b) state requirements for oscillators
 - c) describe the operation of oscillator circuits

Content

- 18.2.5P1 Performance of oscillator circuits
18.2.5P2 Construction of oscillator circuits

18.2.5C Competence

- The trainee should have the ability to:
- i) Construct oscillator circuits
 - ii) Verify performance of oscillator circuits

Content

- 18.2.5T1 Concept of oscillators
Resonance
18.2.5T2 Requirements for oscillators
i) Feedback
ii) Impedance
iii) Positive feedback
18.2.5T3 Operation of oscillator circuits
i) Tuned collector
ii) Rc phase shift

Suggested teaching/Learning Resources

- i) Assorted electronic components
- ii) Power supply
- iii) Oscilloscope
- iv) Multimeter
- v) Electronic toolkit
- vi) Circuit/breadboard
- vii) Connecting leads/wire

Suggested teaching/Learning Activities

- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise

Suggested Evaluation Methods

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

18.2.6 WAVE SHAPING AND PULSE GENERATING CIRCUITS

Theory

18.2.6T0 *Specific Objectives*

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

- describe operation of wave shaping circuits
- explain the operation of pulse generating circuits

Content

18.2.6T1 Operation of wave

- Shaping circuits
- Differentiators
- Integrators
- Integrators
- Clipping circuits
- Clamping circuits

18.2.6T2 Pulse generating circuits (discrete and ICS)

- Monostable multivibrator
- Astable multivibrator
 - schmitt trigger
 - blocking oscillator

Practice

18.2.6P0 *Specific Objectives*

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

- constructor waveshaping and pulse generating circuits
- verify performance of waveshaping and pulse generating circuits

Content

18.2.6P1 Construction of waveshaping and pulse generating circuits

18.2.6P2 Performance of waveshaping and pulse generating circuits

18.2.6C **Competence**

The trainee should have the ability to:

- Construct wave shaping and pulse generating circuits
- Verify the performance of wave shaping and pulse generating circuits

Suggested teaching/Learning

Resources

- Assorted electronic components (discrete/ICS)
- Power supply
- Oscilloscope
- Circuit/breadboard
- Electronic toolkit
- Function generator
- Connecting leads

Suggested teaching/Learning

Activities

- Illustration
- Demonstration
- Note taking

- Observation
- Practical exercise
- Calculations
- Project work

Suggested Evaluation Methods

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

18.2.7 OPTO - ELECTRONICS

Theory

18.2.7T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:

- explain theory of opto-electronics
- explain principles of gaseous and solid lasers and masers
- describe the operation of photo devices
- explain drive requirements for the displays
- state application of photo devices

Content

- 18.2.7T1** Opto-electronic Theory
- Interaction of radiation and matter
 - Absorption, emission and transmission properties of matter
- 18.2.7T2** Principles of lasers and masers
- Construction
 - Operation

- 18.2.7T3** Operation of photo-devices
- Photo resistor
 - Photo diode
 - Photo transistor
 - Photovoltaic cells
 - Avalanche diode
 - PIN diode

- 18.2.7T4** Drive requirements for display
- LED
 - LCD
 - Plasma

- 18.2.7T5** Applications

Practice

18.2.7P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to construct a circuit using photo devices

Content

- 18.2.7P1** Circuit construction
- Design
 - Construction testing

18.2.7C **Competence**
The trainee should have the ability to:

- apply photo devices in electronic circuits
- Diagnose faults in electronic devices

Suggested teaching/Learning Resources

- Photo devices
- Electrical and electronic tools and measuring instruments
- Electronic Bread board
- Copper strip boards

*Suggested teaching/Learning
Activities*

- Illustration
- Demonstration
- Note taking
- Observation
- Practical exercise
- Calculations
- Project work
- Visits to industries

Suggested Evaluation Methods

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