

## 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:

- Understand the characteristics of special semi-conductor devices
- Understand the operation of electronic circuits
- 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"><li>Principles of operation</li><li>Applications of special semiconductor devices</li></ul>	12
18.2.2	Amplifiers	<ul style="list-style-type: none"><li>RC coupled amplifiers</li><li>Analyses of linear amplifiers</li><li>Amplifier gain</li><li>Power amplifier</li><li>Tuned amplifiers</li><li>Wideband amplifiers</li><li>Amplifier distortion</li></ul>	16
18.2.3	Operational Amplifiers (Op-Amp)	<ul style="list-style-type: none"><li>Direct Coupled amplifiers</li><li>Differential amplifiers</li><li>OP-amp characteristics</li><li>OP-amp circuits</li></ul>	16
18.2.4	Feedback	<ul style="list-style-type: none"><li>Feedback principle</li><li>Feedback equations</li><li>Effects of negative feedback</li><li>Feedback connections</li></ul>	10
18.2.5	Sinusoidal Oscillators	<ul style="list-style-type: none"><li>Concept of oscillators</li><li>Oscillation requirements</li></ul>	10

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

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**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

- 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

- 18.2.2T1 RC coupled amplifiers
  - i) Biasing
  - ii) Stability
  - iii) Operating Conditions
- 18.2.2T2 Frequency response low frequency
  - i) Mild-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

### 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

*Suggested Evaluation Methods*

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

**Practice**

- 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) R<sub>c</sub> 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:

- a) explain theory of opto-electronics
- b) explain principles of gaseous and solid lasers and masers
- c) describe the operation of photo devices
- d) explain drive requirements for the displays
- e) state application of photo devices

*Content*

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

- 18.2.7T3 Operation of photo-devices
- i) Photo resistor
  - ii) Photo diode
  - iii) Photo transistor
  - iv) Photovoltaic cells
  - v) Avalanche diode
  - vi) PIN diode
- 18.2.7T4 Drive requirements for display
- i) LED
  - ii) LCD
  - iii) 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
- i) Design
  - ii) Construction testing

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

- i) apply photo devices in electronic circuits
- ii) 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

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