

# **Unit 4022:                      Electronic Circuits and Devices**

**Unit Code:**                      **T/651/0742**

**Level:**                              **4**

**Credits:**                           **15**

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## **Introduction**

Electronics is pervasive and impacts various aspects of modern day living and the society as a whole. Many industries rely upon the use of electronics, thereby creating opportunities in industrial applications and research.

This unit introduces students the operational characteristics of amplifier circuits, the types, and effects of feedback on a circuit performance, and the operation, application of oscillators. They will also be introduced to semiconductor devices and circuits, the use of electronics manufacturers' data to analyse the performance of circuits and devices, the application of testing procedures, and use the findings of the tests to evaluate their operation.

Among the topics included in this unit are: power amplifiers, class A, B and AB; operational amplifiers, inverting, non-inverting, differential, summing, integrator, differentiator; types such as open, closed, positive and negative feedback; frequency, stability, frequency drift, distortion, amplitude, wave shapes and testing procedures.

On successful completion of this unit students will be able to learn about the operational characteristics of amplifier circuits, the types and effects of feedback on an amplifier's performance, the operation and application of oscillators and application of testing procedures to electronic devices and circuits.

## **Learning Outcomes**

By the end of this unit students will be able to:

- LO1 Determine the operational characteristics of amplifier circuits
- LO2 Investigate the types and effects of feedback on an amplifier's performance
- LO3 Examine the operation and application of oscillators
- LO4 Apply testing procedures to electronic devices and circuits.

## Essential Content

### LO1 Determine the operational characteristics of amplifier circuits

*Operational characteristics:*

Power amplifiers: class A, B and AB

Operational amplifiers: inverting, non-inverting, differential, summing, integrator, differentiator, comparator, instrumentation, Schmitt trigger, active filters

Gain, bandwidth, frequency response, input, and output impedance

Distortion and noise.

*Electronic circuits and semiconductors:*

Integrated use of semiconductors and electronic circuits; diodes and transistors, diode applications, Zener diode; operational characteristics.

### LO2 Investigate the types and effects of feedback on an amplifier's performance

*Types and effects:*

Types including open, closed, positive and negative feedback

Effect of feedback on gain, bandwidth, distortion, noise, stability, input, and output impedance

The concept of virtual ground.

### LO3 Examine the operation and application of oscillators

*Operation and application:*

Types of oscillators such as Wien bridge, Twin-T, R-C ladder, L-C coupled, transistor, operational amplifier, crystal

Frequency, stability, frequency drift, distortion, amplitude, and wave shapes.

#### LO4 **Apply testing procedures to electronic devices and circuits**

##### *Testing procedures:*

Measuring performance, using practical results and computer simulations

Voltage gain, current, bandwidth, frequency response, output power, input, and output impedance

Distortion and noise.

##### *Devices to test:*

Introduction of concepts, device usage and testing

Semiconductors

Integrated circuits

Amplifiers

Oscillators

Filters

Power supplies

Integrated circuit (IC) voltage regulators

Combined analogue and digital IC's.

##### *Component manufacturer's data:*

Specifications, manuals, and circuit diagrams.

##### *Use of testing equipment:*

Meters, probes, and oscilloscopes

Signal generators and signal analysers, logic analysers

Virtual test equipment (simulation software)

Effective use of tools and techniques when securely operating and testing systems and components (e.g., networks and devices).

## Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<b>LO1</b> Determine the operational characteristics of amplifier circuits		<b>D1</b> Critically review the results obtained from the application of practical and simulated tests on amplifier circuits studied.
<b>P1</b> Describe the types of amplifiers available using their typical circuits.  <b>P2</b> Determine different performance characteristics of types of operational amplifier.	<b>M1</b> Explain the results obtained from applying practical tests on an amplifier's performance.	
<b>LO2</b> Investigate the types and effects of feedback on an amplifier's performance		<b>D2</b> Analyse the effect of feedback on an amplifier's performance using practical and simulated tests.
<b>P3</b> Investigate the effect of different types of feedback on the operational amplifier's performance.  <b>P4</b> For a given practical scenario, describe how circuits employ feedback.	<b>M2</b> Perform practical tests to show the effect of feedback on an amplifier's performance.	
<b>LO3</b> Examine the operation and application of oscillators		<b>D3</b> Analyse the results obtained from applying practical and simulated tests to oscillators studied.
<b>P5</b> Examine types of available oscillators and their applications.	<b>M3</b> Assess the performance characteristics of different type of oscillators.	
<b>LO4</b> Apply testing procedures to electronic devices and circuits		<b>D4</b> Critically review the results obtained from applying practical and simulated tests to devices and circuits studied.
<b>P6</b> Show use of manufacturer's data sheets in selecting electronic devices for a given context.  <b>P7</b> Apply information derived from manufacturer's data when testing electronic devices and circuits.	<b>M4</b> Perform tests on electronic devices and circuits, recording results and recommending appropriate action.	

## Recommended Resources

*Note: See HN Global for guidance on additional resources.*

### Print Resources

Bird Jo. (2022) *Bird's Electrical Circuit Theory and Technology*. 7th Ed. Routledge

Boylestad R.L. and Nashelsky L. (2013) *Electronic Devices and Circuit Theory*. 11th Ed. Pearson

Floyd T.L. and Buchla D. (2021) *Electronics Fundamentals: Conventional Current*. 10th Ed. Pearson

Horowitz P. and Hill W. (2015) *The Art of Electronics*. 3rd Ed. Cambridge University Press

Makarov S., Ludwig R. and Bitar S.J. (2019) *Practical Electric Engineering*. 2nd Ed. Springer.

Storey N. (2017) *ELECTRONICS A Systems Approach*. 6th Ed. Pearson

Yawale S. and Yawale S. (2022) *Operational Amplifier: Theory and Experiment*. 1st Ed. Springer.

### Journals

*Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.*

[Electronic Devices and Networking Journal](#)

[Electronic Devices Articles from Across Nature Portfolio](#)

[IEEE Transactions on Electron Devices](#)

[Microelectronics Journal](#)

[Power Electronic Devices and Components](#)

### Links

This unit links to the following related units:

*Unit 4019: Electrical and Electronic Principles*

*Unit 5019: Further Electrical, Electronic and Digital Principles*

*Unit 5014: Analogue Electronic Systems.*