1 Module Details

Module Name

Digital Sub-Systems

Nominal duration

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 18 to 20hours.

Module code

NUE703

Discipline code

0703240

2 Module purpose

This module will provide students with the knowledge and skills enabling them to describe and use D/A converters and A/D converters. Additionally students will investigate combinational logic applications for programmable logic devices.

3 Prerequisites

Digital Electronics 2 NE180

4 Relationship to competency standards

This module provides some of the knowledge and skills underpinning competency in the following standards:
National Electrotechnology Industry Standards, Units: NES106, NES206, NES301, NES402, NES501;
Metals and Engineering Industry Standards, Units 18.57A, 18.65A.

5 Content

1. Digital to analog conversion
   - typical applications
   - D/A performance characteristics
   - D/A converter circuitry
     - summing type D/A converter
     - R/2R ladder
   - D/A converter specifications
     - resolution
     - accuracy
     - offset error
     - setting time
     - monotonicity
   - an integrated – circuit D/A converter

2. Analog to digital conversion
   - typical applications
   - A/D performance characteristics
   - types of A/D converters (ADC)
     - digital ramp ADC
     - successive-approximation ADC
     - simultaneous (flash) ADC
     - dual slope ADC
   - an integrated – circuit A/D converter

3. Interface chips and techniques
   - logic interface circuits
     - level translations
     - driving a load (sink and source) from a logic circuit
     - transistor switches

- relays
- opto input and output isolation, driver IC's

- sensor interfacing

4. Programmable logic devices
- applications
- types
  - programmable logic array (PLA)
  - programmable array logic (PAL)
  - erasable PLDs
- circuit architecture and operation
- advantages and disadvantages
- programming requirements

6 Assessment strategy

Assessment methods

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Learning and assessment will take place in a classroom/laboratory environment.

7 Learning Outcome Details

Learning Outcome 1

Describe the operation of D/A converters and list typical applications.

Assessment criteria

1.1 List typical applications of D/A converters.
1.2 List and describe the performance characteristics of D/A converters.
1.3 Describe and verify the operation of R-2R and summing type D/A converters given circuit diagrams.
1.4 Describe and verify the operation of a typical DAC IC.

Learning Outcome 2

Describe the operation of A/D converters and list typical applications.

Assessment criteria

2.1 List typical applications of A/D converters.
2.2 List and describe the performance characteristics of A/D converters.
2.3 Describe the operation of the following A/D converters:
- digital ramp
- dual slope
- successive approximation
- simultaneous (flash).

2.4 Describe and verify the operation of a typical ADC IC.

Learning Outcome 3

Identify and describe the hardware and interface techniques used to interface logic circuits to facilitate level translation and/or isolation.

Assessment criteria

3.1 Sketch circuit diagrams showing how a load can be

	interfaced to a digital logic circuit with a bipolar junction transistor of a field effect transistor. 3.2 List the advantages and disadvantages of a relay compared to solid state switch when used to interface logic circuit to a variety of load conditions. 3.3 Explain the principle of operation of an opto-isolator and its use in isolating a digital circuit from an input signal or an output load. 3.4 Describe the operation of a level translator circuit eg. RS232 interface.
Learning Outcome 4	Define types, applications and programming requirements for programmable array devices.
Assessment criteria	4.1 List the functions and applications of the following: - programmable logic array (PLA) - programmable array logic (PAL) - erasable PLDs 4.2 Describe the operation of a typical PAL device. 4.3 Describe the differences and list advantages/disadvantages for the above programmable logic devices. 4.4 Describe the basic process performed in programming array devices.

8 Delivery of module

Delivery strategy	Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require learning outcome sequence other than that indicated in the module.
Resource requirements	Resources should be sufficient for students to carry out learning activities on an individual basis. This will require the following: PCs with suitable software variable dual rail DC power supplies dual trace cathode ray oscilloscopes analogue and digital multimeters function generators logic trainers logic probes IC types: DAC, ADC miscellaneous electronic components: resistors, capacitors etc Useful references include: PAL Manufacturer's Data Books PAL Device Data Book, Bipolar and CMOS, Advanced Micro Devices, 1990.

	Interface, Bipolar LSI, Bipolar Memory, Programmable Logic Data Book, National Semiconductor Corporation, 1983. Ronald, J. Tocci Digital Systems, Prentice Hall Amin, R. Ismail, Victor, M. Rooney Digital Concepts and Applications, Saunders College Publishing Ronald, J. Tocci Digital Systems: Principles and Applications, Prentice Hall
Occupational Health and Safety Requirements	A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching content.