

**NEW ZEALAND INSTITUTES OF TECHNOLOGY AND POLYTECHNIC  
QUALIFICATIONS IN INFORMATION & COMMUNICATIONS TECHNOLOGY**

**PRESCRIPTION: DE610 DIGITAL ELECTRONICS APPLIED**

AIM OF MODULE:	To enable students to exhibit the knowledge and skills required to construct and successfully demonstrate the operation of a variety of digital electronic circuits, inherent in a wide range of electronic equipment.
CREDITS:	7
KNOWLEDGE ASSUMED FROM:	DE600 Digital Electronics
STUDENT LEARNING HOURS:	70
CONTENT REVISED:	2010
PRESCRIPTION EXPIRY DATE:	November 2013

**Level and Assessment Schedule**

TOPICS	Highest Skill Level				Suggested Assessment Percentage
	R	C	A	P	
1. Logic Families			*		25
2. Programmable Devices			*		50
3. Analogue to Digital (ADC) and Digital to Analogue (DAC) Conversion			*		25
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## LEARNING OUTCOMES

### The student will:

- A 1 Describe the basic circuit configurations and characteristics of range of commercial integrated logic circuits (ICs) currently available and experiment with examples of commercial ICs configured to perform basic functions
- A 2 Construct a programmable device that uses a processor and standard logic circuits, program the assembled device and demonstrate the working device
- A 3 Describe various types of ADC and DAC currently available, their purpose, their applications and examine commercial ADC and DAC data sheets to ascertain the technology used and their typical performance characteristics

## CONTENT

### 1 Logic Families

- A description of the basic circuit configurations and characteristics of a range of commercial integrated logic circuits (ICs), currently available, will include:
  - Describing a TTL NAND gate with a “Totem Pole” output stage and explaining its operation
  - Describing an open-collector TTL NAND gate and its application and explaining its operation
  - Describing an emitter coupled logic NOR gate and explaining its operation
  - Describing a CMOS NAND gate and explaining its operation
  - Comparing TTL, ECL and CMOS gates in terms of supply requirements, power consumption, fan out, compatibility and propagation delay

### 2 Programmable Devices

- Constructing a programmable device that uses a processor and standard logic circuits, programming the assembled device and demonstrating the working device will involve:
  - Constructing a circuit as per instructions, observing the health and safety practices applicable to a lab environment
  - Programming the device using a suitable programming language; e.g. C
  - Fully documenting the program
  - Testing and troubleshooting the device and documenting the processes

### 3 Analogue to Digital (ADC) and Digital to Analogue (DAC) Conversion

- Describing the various types of ADC and DAC and explaining their applications includes:
  - Sketching a simple sample and hold circuit and explaining its operation

- Describing sampling rate theory
- Explaining the operation of an R2R resistor network
- Explaining the operation of a weighted resistor network
- Comparing the advantages and disadvantages of both types of resistor networks
- Explaining the operation of the following types of ADCs:
  - Ramp
  - Tracking
  - Successive approximation
  - Dual Slope
- Describing the parameters that characterise the accuracy of ADCs and DACs including:
  - Resolution
  - Linearity
  - Monotonicity
  - Quantising error
- Giving examples of the application of different types of ADCs and DACs
- Using a data sheet to identify the types of technology used and values associated with various ADCs and DACs currently available

## LEARNING RESOURCES

**Digital Fundamentals** (10th Edition) by Thomas L. Floyd. ISBN-13: 978-0132359238 (Published by Prentice Hall March 29, 2008)

The [Asuro robot](#) is an example of the type of programmable device that can be readily purchased in kitset form to satisfy learning outcome 2 (Accessed 11 August, 2008). The kitset contains:

- An Atmel AVR RISC-processor
- Two independently controlled motors
- Optical linetracer
- Six collision-detector switches
- Two odometer-sensors
- Three indicator LEDs
- IR-Interface for programming and remote controlling this robot by a PC

### ADCs and DACs data sheets:

<http://www.farnell.com/datasheets/68314.pdf> (Accessed August 2010)

[http://www.analog.com/en/analog-to-digital-converters/ad-converters/products/index.html#All\\_ADCs](http://www.analog.com/en/analog-to-digital-converters/ad-converters/products/index.html#All_ADCs) (Accessed August 2010)