# Chapter 3

# Logic

## Summary

Proposition, truth set, tautology, contradiction; negation; joining propositions by *and*, *or*, *exclusive or*; truth table; conditional connectives and their truth tables; contrapositive; laws of logic; logic gate, logic network.

**References:** Epp Sections 1.1, 1.2, 1.4 *or* M&B Sections 2.5, 2.6, 2.7.

## Introduction

Logical argument and deductive reasoning are central to mathematics, and we could not write or test the validity of a computer program without them. In this chapter, we consider the symbolic representation of statements and the laws of logic.

## 3.1 Symbolic Statements and Truth Tables

### Learning Objectives

After studying this section, you should be able to:

- define the truth set of a given proposition;
- recognise when a given proposition is a tautology or a contradiction;
- state the negation of a given proposition;
- construct the truth table for the connectives *not*, *and*, *or* and *exclusive or*.

### 3.1.1 Propositions

The statements with which we are concerned are known as **propositions**. These are statements that are either true or false. Statements that could be considered true by one observer but simultaneously considered false by another observer are *not* propositions.

**Example 3.1** The following sentences are propositions.

(a) This animal is a cat.

(b) This program is in C.

(c) The positive integer $n$ is prime.

(d) The real number x is greater than 5.