CS1011：數位電子導論

Introduction

Introduction

- Engineering is inherently interdisciplinary
- Electrical and Electronic Systems represent a major enabling technology
  - Important to all engineers and scientists
- A system approach to engineering combines
  - A top-down approach
  - A bottom-up approach

Systems

- A system can be defined as

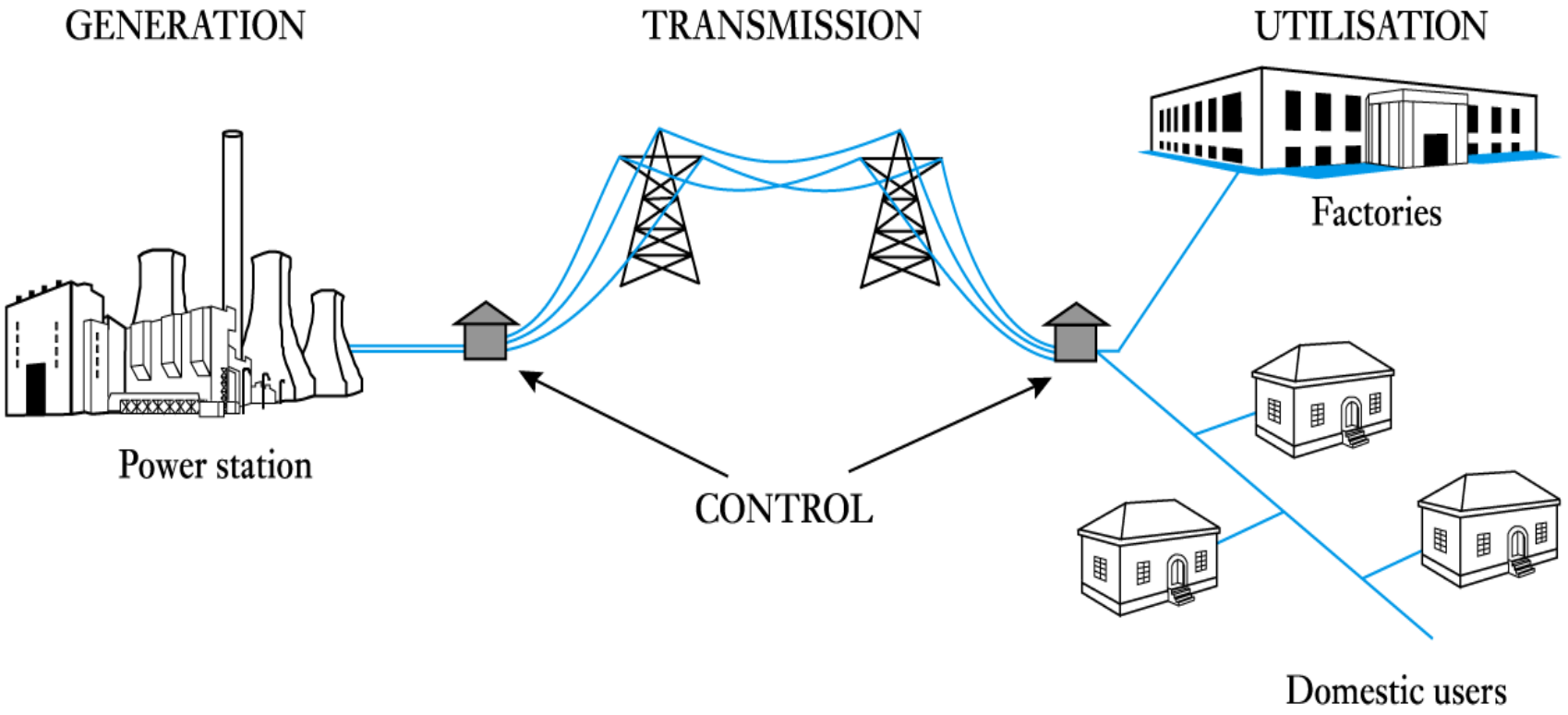
  Any closed volume for which all the inputs and outputs are known

- Examples include:
  - An engine management system
  - An automotive system
  - A transportation system
  - An ecosystem
- Inputs and outputs will reflect the nature of the system

Electrical and Electronic Systems

- **Basic functions include elements concerned with the manipulation of electrical energy**
- **Common functions are:**
  - **Generation**
  - **Transmission of communication**
  - **Control or processing**
  - **Utilization**
  - **Storage**

A Power Distribution System Example

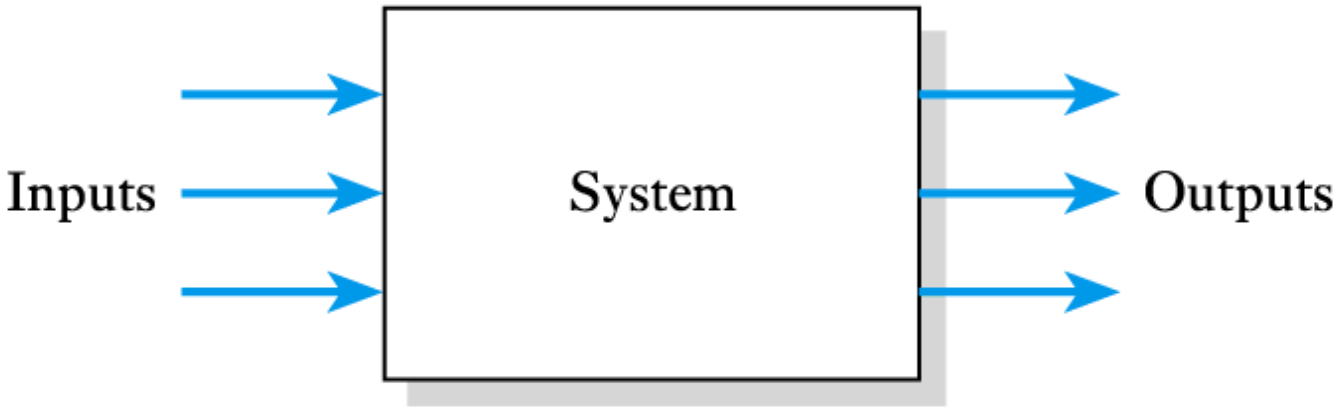


More System Examples

- **Electrical and electronic systems often fall within a range of categories, such as those responsible for:**
  - **Power generation and distribution**
  - **Monitoring of some equipment or process**
  - **Control of some equipment or process**
  - **Signal processing**
  - **Communications**
  - **…**

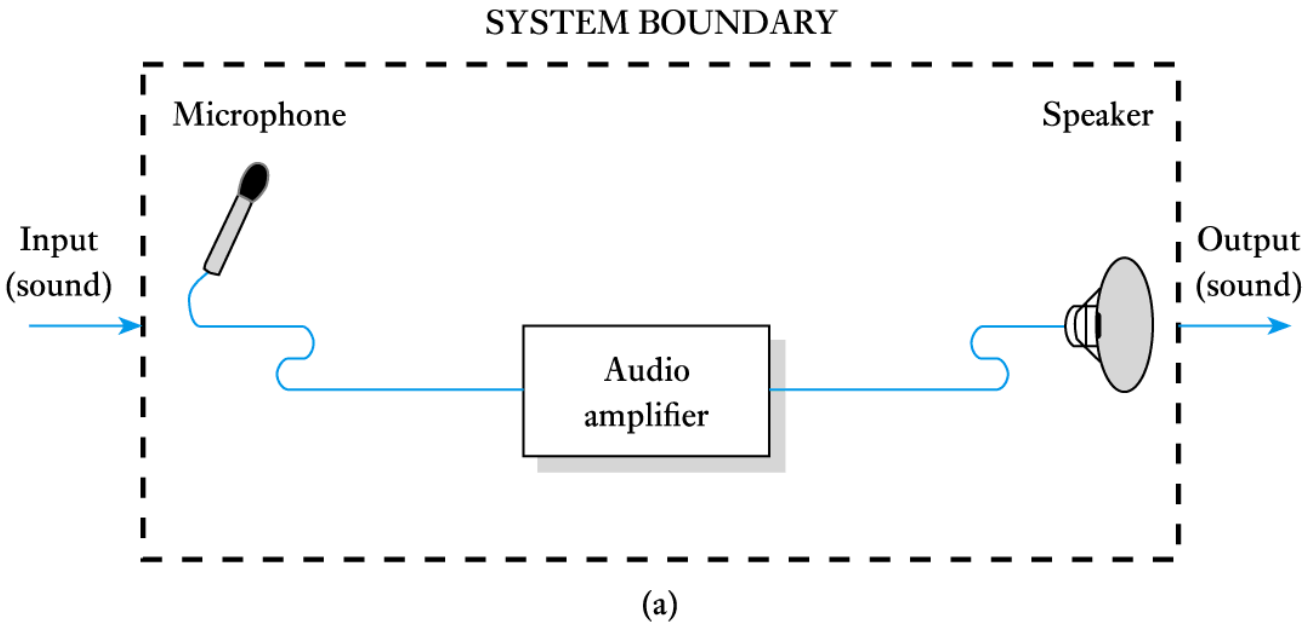
System Inputs and Outputs

- **Systems may often be described simply by their inputs, their output and the relationship between them**



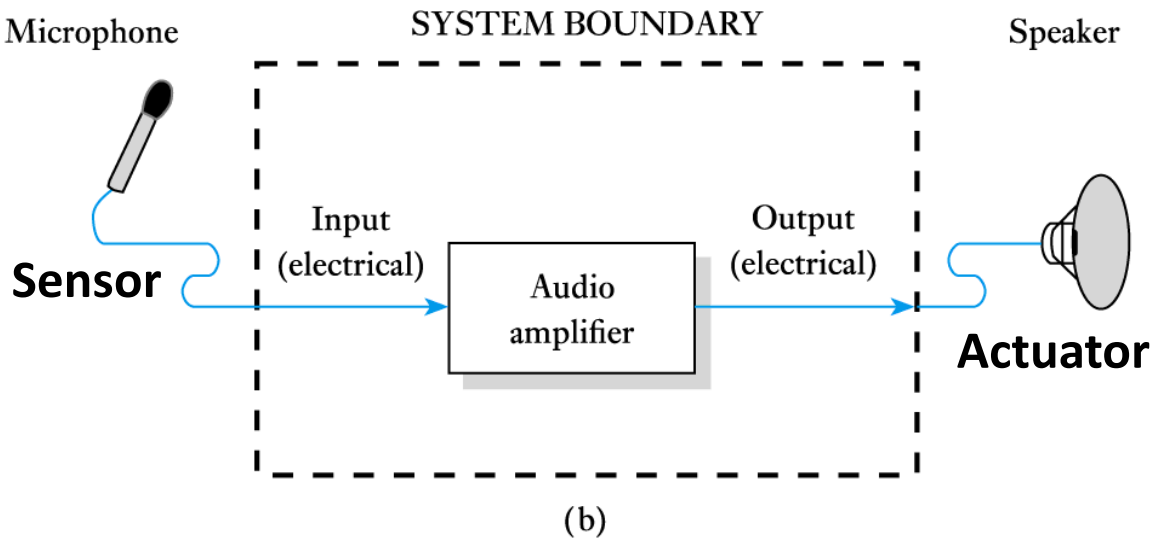
Input/Output Example

- **Nature of inputs/outputs will depend on where we draw our system boundaries. For example:**



System Boundary Could be Changed

- By changing the system boundary we change the nature of the inputs and outputs



Sensors and Actuators

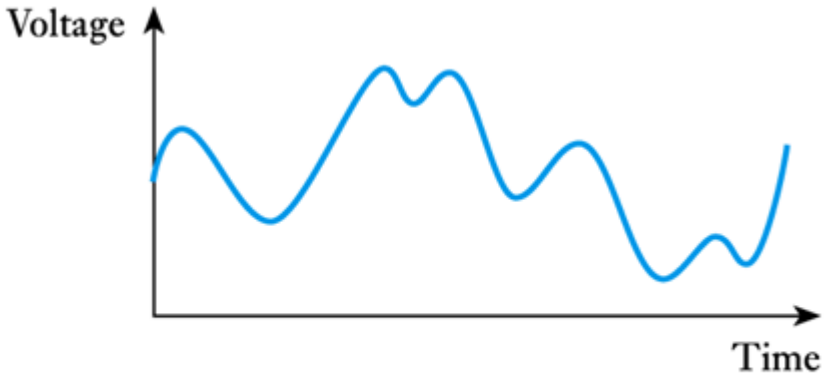
- Components that interact with the outside world are termed sensors and actuators
  - In the previous example, the microphone represents a sensor
  - In the previous example, the loudspeaker represents an actuator
- We will look at sensors and actuators in more detail in later lectures

Physical Quantities & Electrical Signals

- The world about us is characterized by a number of physical properties or quantities
  - E.g., temperature, pressure, humidity, etc.
- Physical quantities may be *continuous* or *discrete*
- Continuous quantities change smoothly and can take an infinite number of values
  - Most real-world quantities are continuous
- Discrete quantities change abruptly from one value to another
  - Many man-made quantities are discrete

Analog Signals

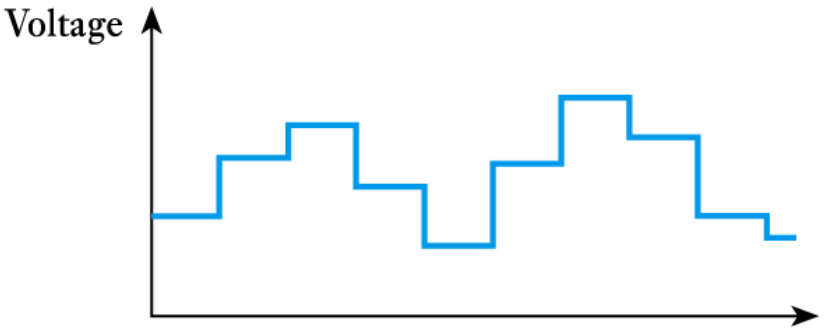
- It is often convenient to represent physical quantities by electrical signals (could be continuous or discrete)
- Continuous signals are often described as analog signals



(a) An analog signal

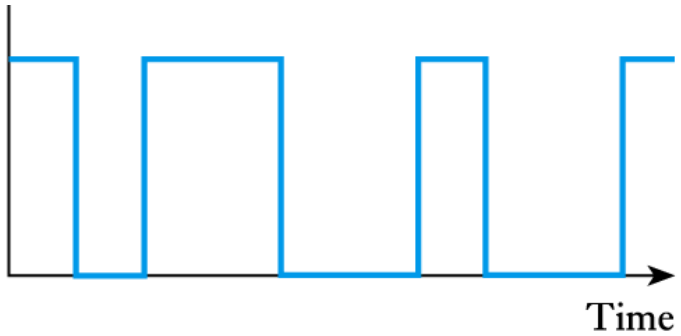
Digital and Binary Signals

- **Discrete signals are often described as digital signals**



(b) A multi-valued digital signal

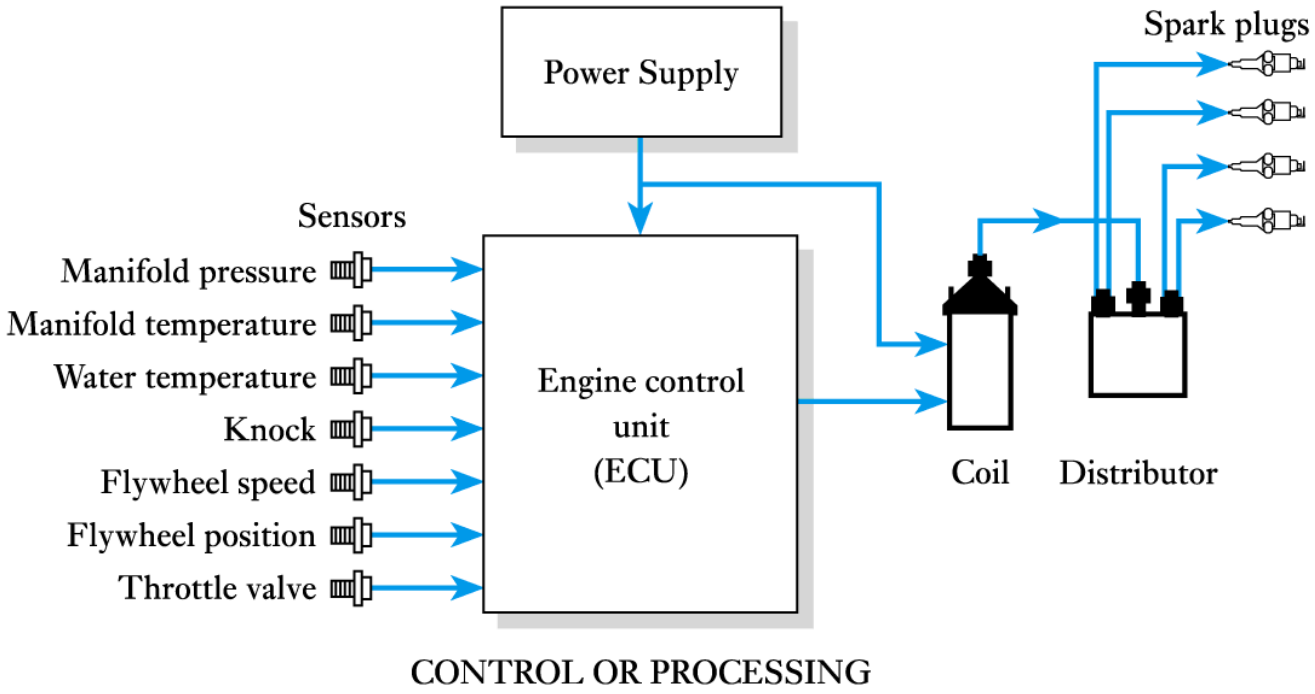
- **Many digital signals take only two values and are referred to as binary signals**



(c) A binary signal

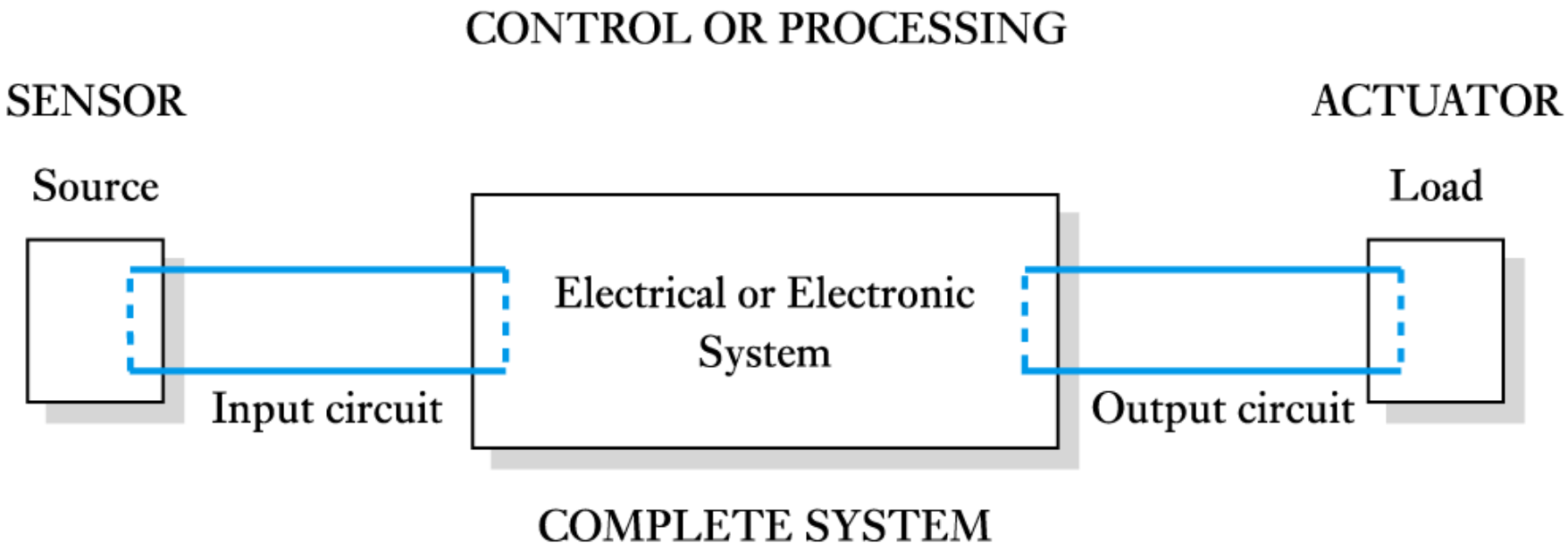
System Block Diagrams

- It is often convenient to represent complex arrangements by a simplified block diagram



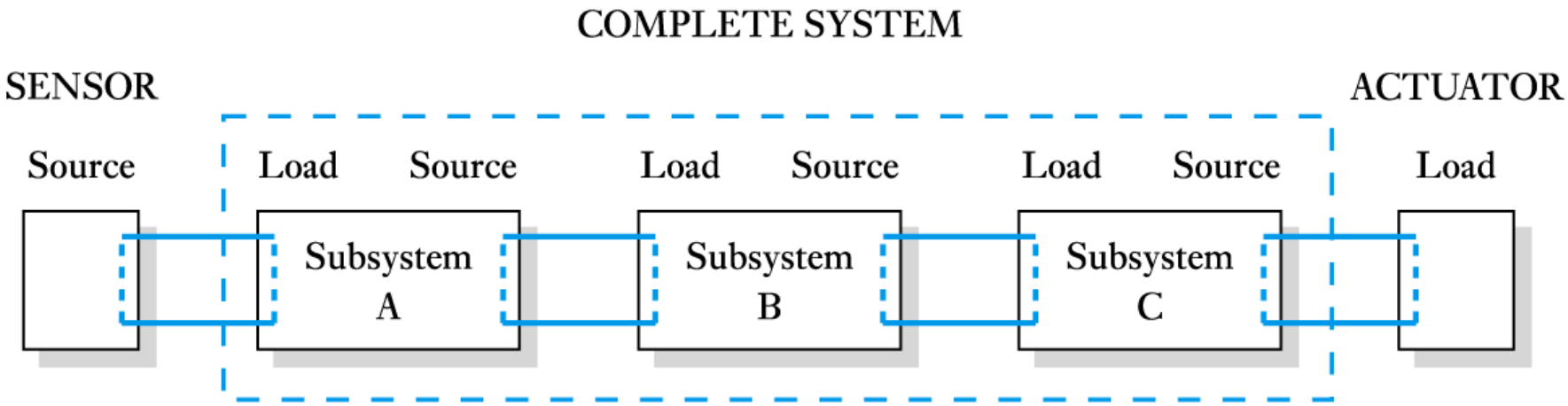
Source/Load for a Complete System

- In an electrical system, a flow of energy requires a circuit - a system with a single input and a single output is shown below
  - this shows the input circuit and the output circuit
  - the sensor represents the source
  - the actuator represents the load



System Partition for a Complex System

- We often divide complex circuits into subsystems or modules – as shown below
  - The output of each module represents a source for the following section
  - The input of each module represents a load to the previous section



Key Points

- Engineering is inherently interdisciplinary
- Engineers often adopt a ‘systems approach’
- Systems may be defined by their inputs, their outputs and the relationship between them
- Systems interact with the world using sensors and actuators
- Physical quantities can be either continuous or discrete
- Physical quantities are often represented by signals
- Complex systems are often represented by block diagrams