

## Unit 230

## Software for embedded systems

### Unit summary

This unit is about Software Rich Systems where both hardware and software form a significant proportion of the total development but where the software dominates.

### Aims

The unit aims to develop a basic theoretical foundation and focus for understanding systems software and systems theory. It includes the development of skills required to understand the principles and practices for the development and management of software for Software Rich Systems.

### Prerequisites

It is expected that candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examination and subject 9107-108 Software and information systems engineering.

### Learning outcomes

There are **four** outcomes to this unit. The candidate will be able to:

- Illustrate the differences between various types of system software (real-time, information systems, fault tolerant)
- Understand the division of hardware/software in embedded systems
- Explain the fundamental needs of the Human Computer Interface and needs of data capture
- Demonstrate quality and management processes

### Guided learning hours

It is recommended that 300 hours should be allocated for this unit. 120 of those hours are actual taught hours. This may be on a full time or part time basis.

### Key Skills

This unit contributes towards the Key Skills in the following areas:

IT4.1

Develop a strategy for using IT skills over an extended period of time.

IT4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required in work involving the use of IT for **two** different, complex purposes.

IT4.3

Evaluate your overall strategy and present the outcomes from your work using at least **one** presentation, showing integration of text, images and number.

## **Occupational Standards**

This unit has been mapped to the following National Occupational Standards:

- 1.4.4 Evaluate designs for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 3.1.1 Determine the installation requirements for engineering products or processes
- 3.1.2 Specify installation methods and procedures to achieve installation requirements
- 4.1.1 Determine the operational requirements of engineering products or processes
- 4.1.2 Specify operational methods and procedures to achieve operational requirements
- 4.3.2 Evaluate operational processes
- 5.1.1 Determine the maintenance requirements of engineering products or procedures
- 5.1.2 Specify maintenance methods and procedures to achieve maintenance requirements
- 6.2.1 Assure the quality of engineering products or processes
- 8.1.1 Maintain and develop own engineering expertise

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### Outcome 1

Illustrate the differences between various types of system software (real-time, information systems, fault tolerant)

#### Knowledge requirements

##### The candidate knows how to:

- 1 explain the following system software
  - a operating systems including real time control and IS
  - b compilers
  - c interpreters
  - d linkers
  - e loaders
  - f diagnostic tools
  - g debugging tools
- 2 explain system development techniques for embedded systems
  - a co-specification and co-design
  - b testing and varification
- 3 use programming languages for control system software development
- 4 explain the notation and classification of systems
- 5 understand System Models, Black Box models and the modelling process
- 6 understand the interaction of systems and the environment

**Note:** a detailed knowledge of specific system software is **not** required although candidates should be able to provide illustrative examples in answer to questions.

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### Outcome 2

Understand the division of hardware/software in embedded systems

#### Knowledge requirements

##### The candidate knows how to:

- 1 determine the division of functionality between hardware/firmware/software components and assess the trade-offs
- 2 explain the principles of fault tolerance in embedded systems
- 3 explain real-time software systems in terms of
  - a definition s
  - b system model
  - c types of hard and soft systems
- 4 understand the problems of concurrency including
  - a mutual exclusion and deadlock
  - b conditions for avoidance of the above
  - c process management
  - d different approaches to concurrency
    - i shared memory
    - ii semaphores
    - iii monitors
    - iv task mechanisms
- 5 understand interprocess communication
  - a close coupled systems
  - b distributed systems
- 6 understand scheduling and allocation of priorities to task/processes
- 7 apply various scheduling algorithms and dynamic allocation of task/processes and appreciate fault tolerance in real time systems
- 8 describe functions and features of the hardware/software interface including
  - a support to facilitate operating system activity
  - b multiprogramming
  - c multitasking
  - d storage management
  - e graphics
  - f window systems
  - g animation
  - h networking
  - i multimedia facsimile

- 9 state the relative advantages and particular configurations of the above including support for compiler building and language translation, execution and debugging

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### Outcome 3

Explain the fundamental needs of the Human Computer Interface and needs of data capture

#### Knowledge requirements

##### The candidate knows how to:

- 1 describe types of Human Computer Interaction (HCI)
  - a menus, icons, forms and graphical user interface (GUI)
  - b user characteristics
  - c screen design
  - d colour
  - e accessibility
- 2 use methods for evaluation of types of HCI, especially for different users
  - a novice
  - b expert
- 3 apply different metaphors for user interface design
- 4 explain data capture
  - a input/output
  - b analogue data acquisition
  - c sampling
  - d reconstruction

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### Outcome 4

### Demonstrate quality and management processes

#### Knowledge requirements

#### The candidate knows how to:

- 1 understand the role of software integrated support environments
- 2 apply computing services management techniques to
  - a performance considerations
  - b installation
  - c security
  - d virus protection
  - e hacking
  - f backup
  - g disaster recovery
  - h contingency planning
  - i management of change
  - j system configuration control
- 3 understand the process of Quality Management including
  - a quality systems
  - b quality manuals
  - c quality plans
  - d standards such as
    - i ISO 9000
    - ii TickiT
  - e inspection methods
  - f auditing
  - g measurement and control
  - h process assessment including
    - i software process improvement
    - ii capability determination such as
      - A European software development model
      - B SPICE
      - C CMM

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### Recommended reading list

<b>Core texts</b>	<b>Author(s)</b>	<b>Publisher</b>	<b>ISBN</b>
Embedded Microprocessor Systems	Ball	Newnes	075067234X
Embedded Systems Design	Berger	Osborne McGraw-Hill	1578200733
Languages for Digital Embedded Systems	Edwards	Kluwer Academic Pub	079237925X
Lectures on Embedded Systems	Rozenberg, Vaandrager	Springer-Verlag Berlin	3540651934
Real-Time Systems and Programming Languages	Burns	Addison Wesley	0201729881
Real-Time Systems Design and Analysis	Laplante	John Wiley	0780334000
Software Process Improvement	Haug, Olsen, Bergman	Springer-Verlag Berlin	3540417877
Software Process Improvement: Concepts and Practices	McGuire	Idea Group Publishing	1878289543