

Unit 226

The technology of manufacturing processes

Unit summary

This unit is about the range of commonly used manufacturing processes and associated materials of manufacture.

Aims

The unit aims to develop the student's awareness of manufacturing processes and the limitations and opportunities placed on manufacturing by workplace behaviour, design constraints, economic aspects, automation and modelling.

Prerequisites

It is expected that the candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examinations.

Learning outcomes

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

- Material behaviour and treatment that is relevant to manufacturing of parts and components
- Casting, moulding, cutting, machining, forming, joining and powder based processes
- Automation of manufacturing processes and control systems

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:

C4.1

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

C4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required in work involving:

- **one** group discussion about a complex subject;
- **one** extended written communication about a complex subject.

C4.3

Evaluate your overall strategy and present the outcomes from your work, using at least **one** formal oral presentation, including the use of two images to illustrate complex points.

Occupational Standards

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

- 1.1.1 Identify the requirements of clients for engineering products or processes
- 1.1.2 Produce specifications for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 2.1.2 Specify production methods and procedures to achieve production requirements
- 2.2.1 Implement production methods and procedures
- 2.2.2 Solve production problems with engineering solutions
- 2.3.2 Evaluate the production process
- 3.1.1 Determine the installation requirements for engineering products or processes
- 3.1.2 Specify installation methods and procedures to achieve installation requirements
- 3.1.4 Schedule installation activities to implement the installation methods and procedures
- 3.2.2 Solve installation problems with engineering solutions
- 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
- 5.2.1 Implement maintenance methods and procedures
- 5.3.2 Evaluate maintenance processes
- 6.1.1 Analyse the risks arising from engineering products and processes
- 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

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Material behaviour and treatment that is relevant to manufacturing of parts and components

Knowledge requirements

The candidate knows how to:

- 1 apply heat treatment to materials to produce the desired properties
- 2 conduct surface treatment and coating processes
 - a surface hardening
 - b PVD
 - c CVD
- 3 assess a materials plasticity
 - a Von Mises and Tresca yield criterion
 - b Coulomb friction and friction factor models
 - c Levy-Mises flow rule
 - d empirical equations to describe stress-strain relations
 - e plastic anisotropy parameters for sheet metal

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Outcome 2

Casting, moulding, cutting, machining, forming, joining and powder based processes

Knowledge requirements

The candidate knows how to:

- 1 describe metal casting processes
 - a sand
 - b die
 - c investment
- 2 describe polymer forming processes
 - a injection moulding
 - b rotational
 - c resin transfer
 - d thermoforming
 - e compression moulding
 - f extrusion moulding
- 3 describe metal forming processes
 - a open and closed die forging
 - b cold forging
 - c tube making processes
 - d sheet drawing and pressing
 - e extrusion of solid and thin walled sections
 - f apply energy, slab and upper bound methods to calculate forming forces
 - g identify the characteristics of forming machinery and tools
 - h appreciate the capabilities of finite element modelling
- 4 evaluate alternative design configurations for moulds and dies in casting and forming processes
- 5 describe mechanical cutting processes
 - a chip formation
 - b cutting forces and power estimation
 - c Taylor's tool life equation
 - d drilling, turning and milling operations
 - e grinding configurations
 - f surface texture and measurement
 - g cutting tool materials as associated ISO/EN standards
- 6 describe laser cutting technology

- 7 describe electro-chemical processes
 - a ECM
 - b EDM rapid prototyping
 - c PVD
 - d CVD
- 8 describe liquid phase joining processes
 - a gas welding
 - b arc welding
 - i SMAW
 - ii SAW
 - iii MIG
 - iv TIG
 - v plasma
 - c laser welding
 - d resistance welding
 - e electron beam welding
 - f friction welding
 - g diffusion bonding
 - h adhesive bonding
- 9 select and carry out weld inspection methods
 - a destructive
 - b non-destructive
- 10 select materials appropriate to the product manufacture or manufacturing process

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Outcome 3

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Automation of manufacturing processes and control systems

Knowledge requirements

The candidate knows how to:

- 1 utilise automation systems in manufacturing
 - a NC
 - b CNC
 - c DNC
- 2 part programme using G codes
- 3 utilise programmable logic control (PLC) methods for
 - a adaptive control
 - b robotics
 - c sensors
- 4 develop and adapt CAD systems and concepts of solid modelling virtual reality
- 5 utilise data transfer in CAD/CAM
- 6 estimate production costs
- 7 plan mechanical and production processes

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Recommended reading list

Core texts	Author(s)	Publisher	ISBN
Computer Integrated Manufacturing and Engineering	Rembold, Nnaji & Storr	Addison-Wesley	0201565412
Introduction to Manufacturing Processes	John Schey	McGraw Hill	0071169113
Manufacturing Engineering and Technology	Kalpakjian, Schmid	Longman HE	0130174408
Robotics	Fu, Gonzales & Lee	McGraw Hill	0071004211
Total Design	Stuart Pugh	Addison-Wesley	0201416395