

# Unit T4: Mechanical Engineering Design

Unit code:	M/503/7340
QCF level:	6
Credit value:	15

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## Aim

This unit aims to develop learners' skills in providing design solutions to proposals and specifications for mechanical engineering products.

## Unit abstract

Mechanical engineering design is of fundamental importance for mechanical engineers and is regarded by the Institution of Mechanical Engineers as a mandatory component of all mechanical engineering degree programmes.

This unit explores the different types of design problems and appropriate approaches needed to solve them. Learners will work in small teams to devise appropriate solutions while considering issues of sustainability and the environment.

Learners will be able to provide detailed design solutions for the main machine elements and how they may be integrated into the mechanical engineering product, and produce a design report.

## Learning outcomes

### On successful completion of this unit a learner will:

- 1 be able to develop outline designs for mechanical engineering products
- 2 be able to develop and integrate detailed designs of elements for mechanical engineering products
- 3 be able to produce a design report.

## Unit content

### 1 **Be able to develop outline designs for mechanical engineering products**

*Design process:* eg buzz groups, evaluation matrices, quality function deployment (QFD), design sketches

*Design considerations:* specification; costs; standards; regulations; statutory bodies; sustainability issues; environmental issues; sources of information, eg technical papers, British and other standards, trade associations, company information, policy and procedures, textbooks, internet

### 2 **Be able to develop and integrate detailed designs of elements for mechanical engineering products**

*Elements:* mechanical power transmission elements, eg shafts, belt drives, clutches, brakes; methods of joining elements, eg, welding, bolted joints; stress concentration; cyclic loading; standard machine elements, eg fasteners, bearings, sensors, actuators; drive systems, eg electric, petrol, diesel, hydraulic, air motors; mechanical power transmission elements, eg gears, chains

*Design integration:* layout sketches; analysis of functionality eg forces, stresses; implementation eg materials, manufacturing processes

### 3 **Be able to produce a design report**

*Report:* solutions considered; justification for choice of optimum; detailed design of elements with explanations (calculations, selection of materials, selection of manufacturing process, selection of appropriate off-the-shelf components, safety and maintenance, legal issues, environmental aspects and sustainability); report format, eg content, length, appropriate language, graphics

## Learning outcomes and assessment criteria

<b>Learning outcomes</b> On successful completion of this unit a learner will:	<b>Assessment criteria for pass</b> The learner can:
LO1 Be able to develop outline designs for mechanical engineering products	1.1 Produce design solutions to a given specification 1.2 Critically appraise design solutions with reference to design considerations
LO2 Be able to develop and integrate detailed designs of elements for mechanical engineering products	2.1 Develop design elements ensuring functionality and compatibility of component parts 2.2 Produce a layout sketch of the product demonstrating functionality of key components 2.3 Justify the selection of appropriate materials and manufacturing processes
LO3 Be able to produce a design report	3.1 Produce a detailed and coherent design report in an appropriate format.

## Guidance

### Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 4	Level 5	Level 6
<i>Unit 2: Engineering Science</i>	<i>Unit 4: Mechanical Principles</i>	<i>Unit T7: Modelling and Simulation for Engineers</i>
	<i>Unit 8: Engineering Design</i>	<i>Unit T14: Advanced Materials</i>
	<i>Unit 25: Engine and Vehicle Design and Performance</i>	

The content of this unit has been designed and mapped against the Engineering Council's current Learning Outcomes for IEng Accreditation. The completion of the learning outcomes for this unit will contribute knowledge, understanding and skills towards the evidence requirements for IEng Registration.

See *Annexe B* for summary of mapping information for IEng Accreditation.

### Essential requirements

It is desirable that this unit be taught via a case study to put the work into context and to give learners ongoing motivation. Assignment(s) could be based on reverse engineering a product and requiring learners to produce an up-rated or competitive similar or related product. This will require workshop space and tools.

## Delivery

A total of 150 hours of notional learning time is recommended for this unit. The study time is made up of:

- 1) a lecture programme of 2 hours per week (about 1.5 hours lecture and 0.5 hours discussion/tutorial) for a total of 20 weeks this is suggested as formal learning time (40 hours)
- 2) workshop-based sessions of 1 hour per week for 20 weeks (20 hours) where learners working in groups carry out reverse engineering of a product and/or prototype manufacture, and testing with lecturer or technician support
- 3) self-study time for learners working in groups to research and write up their work assignments in two or three group reports (90 hours).

It is strongly recommended that learners work in small groups (three to four people) and receive individual marks for their work. This will require: (i) supervisors to sit in on some formal meetings; (ii) each page in the report produced by the group show the name of the learner primarily responsible for the contents; (iii) a system of peer review.

## Assessment

Two or three group reports as described in 'Delivery'.

## Resources

### Books

Grieve D J – *Mechanical Engineering Design Notes: Theme Automotive Engines* (David J Grieve, 2008) ISBN 978-0956003706

Shigley J E and Mischke C R – *Mechanical Engineering Design* (McGraw-Hill Int, 2003) ISBN 978-0071232708

### Websites

[www.mechengdesign.co.uk](http://www.mechengdesign.co.uk)

This website contains interactive resources for mechanical engineering design