2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

# ENGINEERING

## Unit 22

## Engineering and the environment

K/506/7288

Guided learning hours: 60

**VERSION 4 -June 2017 black line indicates updated content**

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# LEVEL 3

# UNIT 22: ENGINEERING AND THE ENVIRONMENT

# K/506/7288

## Guided learning hours: 60

## Essential resources required for this unit: none

## This unit is internally assessed and externally moderated by OCR.

## UNIT AIM

Environmental issues and sustainability are crucial in modern engineering. From legislative, regulatory and ethical perspectives, minimising the impact of engineering on the environment is a high priority.

The aim of this unit is for learners to develop their understanding of how engineering impacts on the environment. By the end of the unit learners should be able to evaluate how environmental concerns both constrain and drive engineering activities, and how engineering has developed to keep up with these demands against the backdrop of globalisation and global manufacturing.

## TEACHING CONTENT

The teaching content in every unit states what has to be taught to ensure that learners are able to access the highest grades.

Anything which follows an i.e. details what must be taught as part of that area of content. Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples in their work, although these do not need to be the same ones specified in the unit content.

For internally assessed units you need to ensure that any assignments you create, or any modifications you make to an assignment, do not expect the learner to do more than they have been taught, but must enable them to access the full range of grades as described in the grading criteria.

**Please note** – if learners are completing this unit as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete the assessment of this unit, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they may have produced in this unit.

| Learning outcomes | Teaching content |
|---|---|
| **The Learner will:** | **Learners must be taught:** |
| 1. Understand sustainability in engineering | 1.1 designing for efficient use of resources<br>1.2 the consequences of not adopting sustainable engineering practices<br>1.3 examples of sustainable resources being used in engineering, i.e.<br>• wood<br>• natural fibres<br>• plastics made from crops<br>• bio diesel<br>1.4 examples of finite resources and how engineering is conserving them, i.e.<br>• petroleum products<br>• metals<br>1.5 strategies for the efficient use of materials, i.e.<br>• reduce<br>• recycle<br>• reuse<br>1.6 the use of recycled material in engineering, i.e.<br>• products made with recycled materials<br>• products made with virgin material |
| 2. Understand the contribution and potential of renewable energy | 2.1 renewable energy technologies, i.e.<br>• wind<br>• wave<br>• tidal<br>• solar<br>2.2 low carbon energy technologies, i.e.<br>• biomass<br>• nuclear<br>• anaerobic digestion<br>• energy from waste |

| Learning outcomes | Teaching ontent |
|---|---|
| **The Learner will:** | **Learners must be taught:** |
| | 2.3 comparison of low carbon and renewable energy technologies<br>2.4 advantages of renewable energy technologies (e.g. reduced pollution, contributes to climate change strategy, energy security, less reliance on fossil fuels)<br>2.5 challenges of renewable energy technologies (e.g. intermittent, cost, new technology, national grid not designed for distributed energy production)<br>2.6 the ongoing role of traditional energy generation and how the environmental impact is being reduced<br>2.7 the contribution of renewable and low carbon energy to the UK's overall energy mix<br>2.8 the potential for renewable and low carbon energy to make a greater contribution to meeting the UKs energy requirements |
| 3. Know how to evaluate UK performance against global, national and local environmental targets related to engineering | 3.1 climate change legislation i.e.<br>• Renewable Energy Directive<br>• carbon targets<br>3.2 The Environment Agency (e.g. Environmental Management legislation, ISO 14001, air pollution, land pollution, water pollution)<br>3.3 current approaches used by government to improve the UK's environmental performance (e.g. carbon tax, carbon credits, publishing carbon footprint data)<br>3.4 UK performance i.e.<br>• benchmarked against other countries<br>• benchmarked against targets |
| 4. Understand environmental arguments for and against global manufacturing | 4.1 examples of products using global manufacturing (e.g. smart phones, aircraft, white goods, wind turbines)<br>4.2 aspects of a global manufacturing supply chain (e.g. research, raw materials, material processing, manufacture of components, assembly, distribution, retail)<br>4.3 environmental impacts of global manufacturing, (e.g. differences between national and international environmental legislation, transportation impacts, waste disposal issues)<br>4.4 factors which lead to global manufacturing i.e.<br>• economies of scale<br>• low labour costs<br>• relaxed manufacturing legislation |
| 5. Know how innovation is making a difference to the way engineering interacts with the environment | 5.1 new engineering technologies and how they may help and/or harm the environment (e.g. LED lighting, hybrid vehicles, stop start technology, 3D printing, battery technology, fuel cells, wireless control, integration of systems)<br>5.2 new engineering materials and how they help and/or harm the environment (e.g. SMART materials, nano technology, composites, alloys, advanced simulations, miniaturisation) |

## GRADING CRITERIA

| LO | Pass | Merit | Distinction |
|---|---|---|---|
| | The assessment criteria are the Pass requirements for this unit. | To achieve a Merit the evidence must show that, in addition to the Pass criteria, the candidate is able to: | To achieve a Distinction the evidence must show that, in addition to the Pass and Merit criteria, the candidate is able to: |
| 1. Understand sustainability in engineering | P1<br>Explain what is meant by 'sustainability' in engineering. | M1<br>Assess how successfully engineering is conserving finite resources through more efficient use of materials and the use of sustainable and recycled materials. | |
| | P2<br>Explain the consequences of not adopting sustainable engineering practices. | | |
| 2. Understand the contribution and potential of renewable energy | P3<br>Explain the advantages and challenges of renewable energy technologies. | M2<br>Explain the difference between renewable energy and low carbon energy. | D1<br>Evaluate the potential for renewable and low carbon energy to make a greater contribution towards meeting the UK energy requirements. |
| | P4<br>Explain the role of traditional energy generation in the UK's energy mix. | | |

| LO | Pass | Merit | Distinction |
|---|---|---|---|
| 3. Know how to evaluate UK performance against global, national and local environmental targets related to engineering | P5<br>Describe the legal carbon reduction targets that the UK has committed to. | M3<br>Evaluate the progress made by the UK towards meeting carbon reduction targets and suggest improvements which could be made. | |
| | P6<br>Use statistics and data to compare the UKs performance against global environmental targets and the performance of other nations<br>**Synoptic assessment – Unit 1 Mathematics for engineering* | | |
| | P7<br>Explain how the work of the Environment Agency supports the government in meeting its targets. | | |
| 4. Understand environmental arguments for and against global manufacturing | P8<br>Describe the global manufacture of a specific product. | M4<br>Explain why an organisation might choose to adopt a global manufacturing strategy that may have a negative environmental impact. | D2<br>Discuss how the environmental impact of global manufacturing and the factors which lead to global manufacturing could be reduced. |
| | P9<br>Explain the environmental impacts of global manufacturing. | | |
| 5. Know how innovation is making a difference to the way engineering interacts with the environment | P10<br>Explain how new engineering technologies have had positive and negative impacts on the environment. | M5<br>Evaluate the impact of new engineering materials on the environment. | |

## *SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

When learners are taking an assessment task, or series of tasks, for this unit they will have opportunities to draw on relevant, appropriate knowledge, understanding and skills that they will have developed through other units. We've identified those opportunities in the grading criteria. Learners should be encouraged to consider for themselves which skills/knowledge/understanding are most relevant to apply where we have placed an asterisk.

## ASSESSMENT GUIDANCE

LO1: Understand sustainability in engineering
Learners should able explain and assess sustainability in engineering. Teachers might use suitable case studies on which learners could base their investigations.

LO2: Understand the contribution and potential of renewable energy
Learners should be able to demonstrate understanding of renewable energy. Teachers may be able to make available to learners data to evaluate regarding UK energy requirements and how renewable energy contributes to energy production.

LO3: Know how to evaluate UK performance against global, national and local environmental targets related to engineering
Learners might use actual data in order to evaluate UK performance against targets and the performance of other nations. P6 provides an opportunity to apply knowledge of statistical analysis learnt in Unit 1.

LO4: Understand environmental arguments for and against global manufacturing
Learners might use case studies of actual engineered products and their manufacture to demonstrate understanding of environmental impacts of global manufacturing.

LO5: Know how innovation is making a difference to the way engineering interacts with the environment
Teachers might provide learners with examples of specific engineering products or services to investigate in order that they can demonstrate knowledge of how innovation and the use of new materials impact on the environment.

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: http://www.ocr.org.uk/i-want-to/skills-guides/.

## MEANINGFUL EMPLOYER INVOLVEMENT - a requirement for the Foundation Diploma, Diploma and Extended Diploma (tech level) qualifications

The 'Diploma' qualifications have been designed to be recognised as Tech Levels in performance tables in England. It is a requirement of these qualifications for centres to secure for every learner employer involvement through delivery and/or assessment of these qualifications.

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content.

Eligible activities and suggestions/ideas that may help you in securing meaningful employer involvement for this unit are given in the table below.

Please refer to the *Qualification Handbook* for further information including a list of activities that are not considered to meet this requirement.

| Meaningful employer engagement | Suggestion/ideas for centres when delivering this unit |
|---|---|
| 1. Learners undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification. | • Learners undertake work placements in businesses that have the ISO 14001 management system in place and operating.<br>• Employers host in-centre or industrially placed master classes which showcase exemplary use of environmental controls and carbon reduction techniques.<br>• Learners are taken through a site induction which should include the environmental issues for the site they are visiting (e.g. sustainable waste management) |
| 2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s). | • Industrial practitioners launch learning activities that are current live projects.<br>• Employers set energy efficiency challenges where students have to carry out an energy assessment of part of the site and suggest ways of improving energy efficiency. |

| Meaningful employer engagement | Suggestion/ideas for centres when delivering this unit |
|---|---|
| 3. Learners take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures. | • Master classes where employers showcase best practice methodologies used in global manufacturing.<br>• Lectures, talks or seminars by engineering managers that explain how their products or services have changed, and modern innovations that led to the changes.<br>• Employers deliver sessions that showcase the link across skills and units. This could include the link between sustainability and lean manufacturing.<br>• Employers deliver sessions that showcase the link between energy efficiency and the statistical analysis explored in mathematics, quantifying saving made in terms of carbon output and money. |
| 4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a learner's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification. | • Employers review the standard of an industrial level task that learners have been set. This could be a sustainability challenge, a carbon reduction challenge or a manufacturing strategy challenge, possibly incorporating the unit Lean and Quality. |

To find out more
**ocr.org.uk/engineering**
or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**



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