**Unit 1: The Engineered World**

## Scheme of work

Guided learning hours (GLH): 30  
Number of lessons: 20  
Duration of lessons: one/two hours (as shown)

This scheme of work is provided to help you make the most of your planning time. Customise this by adding your own activities/lesson ideas to the ‘Activities’ column.

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<td>1</td>
<td><strong>Tutor presentation</strong> (approx. 10 minutes) to introduce the unit: outline the nature of the learning aims and of the assessment that learners will be expected to complete.</td>
<td><strong>Learning aim A: Know about engineering processes used to produce modern engineered products</strong></td>
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### Lesson 1 (1 hour)

**Topic A1 Engineering sectors and products**  
Types of products from the following engineering sectors:  
- aerospace  
- automotive  
- communications  
- electrical/electronic  
- mechanical  
- biomedical  
- chemical

- **Tutor presentation**, e.g. using PowerPoint or other presentation materials.  
- Introduction to engineering, and how things have changed since the building of the pyramids 4000 years ago.  
- Develop the idea of sectors, each responsible for a certain type of engineering.  
- **Group activity**: Learners work in small groups to identify sectors associated with services/products.

### Lesson 2 (2 hours)

**Topic A2 Mechanical and electrical/electronic engineering processes**  
Processes including health and safety issues, characteristics, applications and  
- **Tutor presentation**, e.g. using PowerPoint or other presentation materials.  
- **Tutor presentation** introduction to the use of machine tools for shaping materials. Demonstrations/video of drilling, milling and turning.

| Unit 2: Investigating an Engineering Project  
| Unit 3: Health and Safety in Engineering  
| Unit 7: Machining |
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<td></td>
<td>advantages/disadvantages of the following engineering processes: ● machining – turning, milling, drilling ● forming – casting, forging</td>
<td>● Learners record the typical uses of each piece of equipment. ● Tutor-led discussion of safety issues associated with machining. ● Tutor presentation introduction to forging and casting, using appropriate demonstration or video.</td>
<td>Techniques</td>
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<td>3 (2 hours)</td>
<td>Topic A2 continued: Processes including health and safety issues, characteristics, applications and advantages/disadvantages of the following engineering processes: ● fabrication – welding, shearing ● electrical/electronic – PCB manufacture, surface mount technology</td>
<td>● Tutor presentation e.g. using PowerPoint or other presentation materials. ● Tutor-led review of machining and forming ● Discuss methods of joining together – welding, brazing and cutting by shearing. ● Paired work: Learners produce a short presentation to explain the different types of welding and typical uses. ● Activity: Discuss using soldering for making circuits.</td>
<td>Unit 2: Investigating an Engineering Project Unit 3: Health and Safety in Engineering Unit 7: Machining Techniques Unit 8: Electronic Circuit Design and Construction</td>
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<td>4 (2 hours)</td>
<td>Topic A3 Scales of production Characteristics and advantages/disadvantages of the following scales of production used in engineering manufacture: ● one-off/jobbing production ● batch production ● mass production ● continuous production</td>
<td>● Tutor presentation e.g. using PowerPoint or other presentation materials. ● Tutor-led discussion of the key features of the four scales of production. ● Individual activity: Learners investigate products that are one-off, batch etc. ● Plenary activity: Learners feed back their findings to the group.</td>
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<td>5 (1 hour)</td>
<td>Topic A4 Modern production methods Applications and advantages/disadvantages of the following modern production methods for production/assembly lines: ● robots</td>
<td>● Tutor presentation e.g. using PowerPoint or other presentation materials. ● Group discussion: What is a robot? Discuss the types of robot that can be used (ROVs, assembly etc). ● Individual activity: Learners to select one type of robot and investigate how the use of their robot has impacted engineering. The results should be presented as a report</td>
<td>Unit 6: Computer-aided Engineering</td>
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<td>● CNC machinery</td>
<td>or presentation.</td>
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<td>● Plenary discussion: CNC equipment, and links to CAD CAM. Demonstrate CNC equipment in use and explain why using CNC equipment is beneficial.</td>
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<td>● Paired activity: Learners investigate the advantages and disadvantages of using CNC equipment.</td>
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**Learning aim B: Know about developments in engineering materials and technologies**

#### 6 (1 hour)

**Topic B1 Modern and smart materials in engineering**

Applications, characteristics, properties and advantages/disadvantages of the following modern and smart materials used in engineering:

- Modern composite materials
  - GRP
  - carbon fibre
  - Kevlar®

- Tutor presentation e.g. using PowerPoint or other presentation materials.
- Group discussion to consider composites. Uses, features and reasons for use. Discuss use of composites in racing cars, aircraft and as safety materials.
- Individual activity: Learners to research and record their findings.

Unit 5: Engineering Materials

#### 7 (1 hour)

**Topic B1 continued:**

Applications, characteristics, properties and advantages/disadvantages of the following modern and smart materials used in engineering:

- Modern high performance materials
  - tungsten
  - titanium
  - nickel/cobalt super alloys
  - ceramics

- Tutor presentation e.g. using PowerPoint or other presentation materials.
- Group discussion to review composites.
- Expand to consider high performance metals.
- Discuss use of high performance metals in vehicles, sports equipment, turbines.
- Individual activity: Learners to research and record their findings.

Unit 5: Engineering Materials
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| 8 (1 hour) | **Topic B1 continued:** Applications, characteristics, properties and advantages/disadvantages of the following modern and smart materials used in engineering:  
  - Smart materials  
    - SMAs  
    - shape memory polymers  
    - electrochromic materials  
    - piezoelectric actuators and transducers |  
  - **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
  - Review learning of composites and high performance materials. Introduce the idea of smart materials – ones that react to changes in the environment.  
  - Use video clips to show smart materials in use.  
  - **Group activity:** Small groups to produce a presentation about their given smart material.  
  - **Plenary activity:** Learners feed back their findings to the whole group. | **Unit 5: Engineering Materials** |
| 9 (1 hour) | **Topic B2 Modern material foams in engineering** Applications, characteristics and advantages/disadvantages of metallic foams as used in the automotive, biomedical and aerospace sectors e.g. aluminium, steel. |  
  - **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
  - **Tutor introduction** to the concept of metal foams, and principals associated with them.  
  - **Individual activity:** Learners produce a fact sheet about metal foams and their uses. | **Unit 5: Engineering Materials** |
| 10 (1 hour) | **Topic B3 Modern material processes in engineering** Process, applications, characteristics and advantages/disadvantages of powder metallurgy:  
  - powder mixing/blending  
  - pressing/compacting  
  - sintering |  
  - **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
  - Show a short video of powder metallurgy, followed by tutor led discussion about powder metallurgy.  
  - **Group activity:** Learners investigate products that are engineered using powder metallurgy.  
  - **Plenary activity:** Groups to present their findings. | **Unit 5: Engineering Materials** |
| 11 (2 hours) | **Topic B4 New technologies in engineering** Applications, characteristics and advantages/disadvantages of the |  
  - **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
  - **Tutor-led discussion:** What do learners consider new technologies to be? | **Unit 5: Engineering Materials** |
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| 5      | Following new technologies used in engineering sectors:  
|        |   - optical fibres in communication  
|        |   - hydrogen fuel cells  
|        |   - surface nanotechnologies  
|        |   Video presentation: Use appropriate video clips to demonstrate optical fibres, fuel cells and surface nanotechnologies.  
|        |   Activity: to investigate the benefits of using these technologies over traditional methods. |          |                      |
| 12 (2 hours) | **Topic B4 continued:**  
|        | Applications, characteristics, properties and advantages/disadvantages of the following new technologies used in engineering sectors:  
|        |   - telematics  
|        |   - blended wing bodies  
|        |   - bionics  
|        |   Tutor presentation e.g. using PowerPoint or other presentation materials.  
|        |   Review prior understanding of new technologies.  
|        |   Give a brief introduction into telematics, blended wing bodies and bionics.  
|        |   Activity: Learners to investigate the potential uses of the three new technologies. |          | Unit 5: Engineering Materials |
| 13 (1 hour) | **Topic C1 Sustainable engineered products**  
|        | Characteristics, applications and advantages/disadvantages of LCA at the following stages for engineered products:  
|        |   - raw materials extraction  
|        |   - material production  
|        |   Tutor presentation e.g. using PowerPoint or other presentation materials.  
|        |   Tutor-led discussion introducing Life Cycle Assessment (LCA) and the six stages.  
|        |   Introduce concepts of raw material extraction and material production.  
|        |   Activity: Learners investigate the impacts of material extraction and production and produce a presentation. |          | Unit 2: Investigating an Engineering Product  
|        | Unit 5: Engineering Materials |
| 14 (1 hour) | **Topic C1 continued:**  
|        | Applications, characteristics, properties and advantages/disadvantages of LCA at the following stages for engineered products:  
|        |   - production of parts  
|        |   - assembly  
|        |   Tutor presentation e.g. using PowerPoint or other presentation materials.  
|        |   Tutor-led review of LCA and stages covered so far.  
|        |   Tutor introduction to production of parts and assembly.  
<p>|        |   Activity: Learners to produce presentation covering the two topics of production of parts and assembly. |          | Unit 2: Investigating an Engineering Product |</p>
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| 15 (1 hour) | **Topic C1 continued:** Applications, characteristics, properties and advantages/disadvantages of LCA at the following stages for engineered products:  
- use  
- disposal/recycling |  
- **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
- **Tutor-led review** of LCA and the stages covered so far.  
- **Tutor introduction** to product use and disposal/recycling  
- **Activity:** Learners to produce their presentation covering the two topics of use and disposal. | Unit 2: Investigating an Engineering Product |
| 16 (2 hours) | **Topic C2 Minimising waste production in engineering**  
Characteristics, applications and advantages/disadvantages of minimising waste production throughout the life cycle of engineered products, using the four Rs:  
- Reduce materials and energy.  
- Reuse materials and products where applicable. |  
- **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
- **Tutor-led activity** to discuss the four Rs – why are they important and how do they influence engineering?  
- **Activity:** Learners to identify methods to reduce energy use in manufacturing, and methods to reuse materials and products. Their findings to be recorded. |
| 17 (2 hours) | **Topic C2 continued:**  
Characteristics, applications and advantages/disadvantages of minimising waste production throughout the life cycle of engineered products, using the four Rs:  
- Recover energy from waste  
- Recycle materials and products or use recycled materials |  
- **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
- **Tutor-led discussion** reviewing reduce and recover. Introduce concepts of recovery and recycling.  
- **Activity:** Learners to identify methods to recover energy from waste, and also the processes used to recycle two different products. Their findings to be recorded. |
| 18 (2 hours) | **Topic C3 Lean manufacturing**  
Characteristics, applications and advantages/disadvantages of minimising waste at the production stage in  |  
- **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
- **Tutor led discussion** – what is lean manufacture? Discuss each of the three methods in turn. |
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|        | engineering, using the following lean manufacturing techniques: | • **Paired activity:** Learners describe the similarities and differences between the three. Findings to be recorded.  
• Individual activity: Learners to look at how one method is used by an engineering company, explaining how efficiency is improved as a result. | |
| 19 (2 hours) | **Topic C4 Renewable sources of energy in engineering**  
Processes, characteristics, applications and advantages/disadvantages of using the following renewable sources of energy in engineering:  
• wind energy using turbines and wind farms  
• solar energy using photovoltaic cells and solar water heaters | • **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
• **Tutor-led discussion** to find prior knowledge of renewable energy.  
• **Paired activity:** One member of the pair to investigate wind energy, the other solar energy. They then teach each other what they have learnt. The joint findings are then recorded. | |
| 20 (2 hours) | **Topic C4 continued:**  
Processes, characteristics, applications and advantages/disadvantages of using the following renewable sources of energy in engineering:  
• hydro energy using dams, barrages and wave power  
• geothermal energy using heat pumps and exchangers | • **Tutor presentation** e.g. using PowerPoint or other presentation materials.  
• Discuss the findings from the previous week; consider the benefits etc, of the two sources considered.  
• **Paired activity:** Pairs to consider hydro energy and geothermal energy. Learners to record their research. | |

**TOTAL: 30 hours**

*See the specification for full details of unit content.*