# Scheme of work – R038 Principles of engineering design

## About this scheme of work

**Our redeveloped Cambridge National in Engineering Design J822 is for first teaching from September 2022.**

This qualification provides lots of flexibility, allowing you to find the best route to suit your centre’s needs.Our curriculum planner shows you at a high level how you could teach the course over two or three years. Our schemes of work provide examples of how you could deliver each unit, integrating the knowledge and understanding learned in the externally assessed unit.

All schemes of work should provide an opportunity for integrating the knowledge and understanding learned from the externally assessed unit content alongside the NEA assessment content. This scheme of work provides one example for delivery of this unit. You may find that a different approach would work better in your centre. We have provided a blank template should you wish to create your own or adapt one of the approaches provided.

You’ve given us lots of feedback on what you need from a scheme of work, so we’ve made sure this resource features:

* a **unit-specific** and **lesson by lesson** approach
* **simple** and **editable** Word format – or you can use our [blank template](https://www.ocr.org.uk/Images/639549-scheme-of-work-template.docx) to create your own version
* links to our [curriculum planner’s first model](https://www.ocr.org.uk/Images/619712-curriculum-planner.docx) which is one teacher teaching the qualification over two years, broken down into half terms
* each lesson’s **key terms**
* **ideas** for teaching and learning with useful **links**
* some ‘warm up’ teaching ideas if you’re teaching over three years.

**Our redeveloped Cambridge Nationals can be tailored to suit your needs – so this scheme of work and the lesson ideas are only suggestions.**



## Units and guided learning hours

Here is a reminder of the **three mandatory units** in the redeveloped Cambridge National in Engineering Design:

| **Unit** | **Unit title** | **Guided learning hours (GLH)\*** | **How are they assessed?** | **Mandatory or optional?** |
| --- | --- | --- | --- | --- |
| **R038** | **Principles of engineering design** | 48 | E | M |
| R039 | Communicating designs | 36 | NEA | M |
| R040 | Design, evaluation and modelling | 36 | NEA | M |

\*GLH (guided learning hours) is the approximate time that the teacher will spend supervising or directing study time and assessment activities.

## Assumptions

* You will adapt the SOW and lesson content to match your own timetabling arrangements and will choose how to spread the 48 GLH over the two years as best fits your needs. We have worked on the basis that the average lesson time is around 45 minutes.
* Students can access some resources outside of lessons for any online homework or extension tasks.
* You will refer to the [specification](https://www.ocr.org.uk/Images/610944-specification-cambridge-nationals-engineering-design-j822.pdf) as the key document for detailed insight into the qualification’s content and assessment requirements.

Summary of software/other equipment in this scheme of work

* Basic drawing equipment (e.g. rule, pencils, paper etc.) to produce sketches and engineering drawings.
* Suitable physical products to investigate, evaluate or test.
* CAD models to illustrate CAD modelling, simulation and evaluation (if available).
* Practical resources to demonstrate manufacturing processes (if available).

## First year of teaching

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| Autumn 1 | |
| **Summary of what you  will cover (from** [**curriculum planner**](https://www.ocr.org.uk/Images/619712-curriculum-planner.docx)**):** | **Designing processes, stages and strategies, cyclic approach**  **Sketching and drawing, CAD** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson key words | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1  Designing processes  1.1 The stages involved in design strategies | You could begin the unit with an introduction to strategies used in design.  In the first lesson you could:   * introduce linear design, inclusive design, user-centred design * give an overview of the key features of each strategy, the context in which they are applied * explain the relevant stages * hold a class discussion on the advantages and disadvantages of each strategy * explore suitable examples of products designed using the different strategies. | **Linear design**  **Inclusive design**  **User-centred design** | Summarise the key aspects and steps involved with the following design strategies: linear design, inclusive design, and user-centred design. | [What is inclusive design?](http://www.inclusivedesigntoolkit.com/)  University of Cambridge  (inclusivedesigntoolkit.com)  [Human-centred design explained with examples](https://uxdesign.cc/human-centered-design-explained-with-examples-707133acf8b4) by Cibin KS, UX Collective  [(uxdesign.cc)](https://uxdesign.cc/human-centered-design-explained-with-examples-707133acf8b4) |  |
| 2 | TA1  Designing processes  1.1 The stages involved in design strategies | Continue this lesson with the remaining design strategies - sustainable design, ergonomic design and iterative design.  As for the previous lesson, you could explore for each strategy:   * the key characteristics * context * advantages and disadvantages.   The final strategy to look at will be iterative design, which is the focus of the next section (1.2).  Students could use flash cards to work in groups to recall the key features of each different design strategy. | **Sustainable design**  **Ergonomic design**  **Iterative design** | Summarise the key aspects and steps involved with the following design strategies: sustainable design,  ergonomic design and iterative design. | [Great examples of sustainable design,](https://turbofuture.com/industrial/Great-Examples-of-Sustainable-Design) T McNerney, Turbofuture  [12 Awesome examples of ergonomic product design](https://www.cadcrowd.com/blog/12-awesome-examples-of-ergonomic-product-design/),  P Skidmore (cadcrowd.com) | R039/R040  Students will follow an iterative design process in both units |
| 3 | TA1  Designing processes  1.2 Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach  1.2.1 Design | At the start of this lesson, you could:   * recap to confirm the iterative design strategy and the stages involved (identify, design, optimise and validate). * then focus on the identify phase by considering the contents of the design brief. * present an example design brief and analyse the key contents of the design brief.   Students could then work in groups to analyse, summarise and feedback on further example design briefs. | **Design brief (analysis of)** | Recall and explain the stages of an iterative design process: identify, design, optimise and validate.  Analyse the key items in a design brief. | [Iterative design process – Design strategies, GCSE Design and Technology,](https://www.bbc.co.uk/bitesize/guides/zjjkw6f/revision/4) BBC Bitesize (bbc.co.uk) | R039/R040  Students are required to analyse a design brief for the assessment in both units |
| 4 | TA1  Designing processes  1.2 Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach    1.2.1 Design | This lesson could follow on from analysis of the design brief.  You could:   * look at different methods of researching product requirements as part of the identify phase of the iterative design process. * introduce students to primary and secondary research along with examples of information sources of each. This could include the purpose of market research and interviews and focus groups. * ask students to examine how the information from research feeds into the design process, including the relative advantages and disadvantages of a range of different methods. They could practise carrying out some simple market research or conducing a brief interview. | **Research methods**  **Primary research**  **Secondary research**  **Interviews**  **Focus groups** | Explain the difference between primary and secondary research, identify sources that fall under each type, and relate this to the design process.  Explain where and why interviews and focus groups are used in design. | [Marketing research, GCSE revision](https://revisionworld.com/gcse-revision/business-studies/marketing/marketing-research) (Revisionworld.com) | R040  Students are required to analyse a product using primary and secondary research |
| 5 | TA1  Designing processes  1.2 Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach  1.2.1 Design | You could begin the lesson with an introduction to ergonomics (using suitable examples) and how anthropometric data is used to determine product dimensions and geometry from an ergonomic perspective.  You could give students example product scenarios and task them to use ergonomic data tables to suggest key dimensions. Example products to determine key dimensions for could include a desk, chair, bicycle, light switch etc. | **Ergonomics**  **Anthropometric data** | Explain ergonomics, and the purpose of using anthropometric data in product design. Be able to use anthropometric data to suggest product design features. | [Ergonomics and Anthropometrics video](https://www.youtube.com/watch?app=desktop&v=mOlFP6bISAI) - YouTube |  |

| Autumn 2 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Sketching and drawing, CAD** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson key words | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1  Designing processes  1.2 Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach    1.2.1 Design | In this lesson students will continue to develop their understanding of the identify phase of the iterative design cycle by investigate existing products.  You could introduce them to:   * the ACCESS FM method (Aesthetics, Cost, Customer, Environment, Size, Safety, Function, Materials and Manufacturing) * how products are investigated through safe disassembly. Note this would be an introduction as ACCESS FM and product disassembly are revisited later in this module and in detail in Unit R040. Suitable product examples could be selected as case studies and used to illustrate these approaches. | **ACCESS FM**  **Product disassembly** | Explain the ACCESS FM approach and how it is used in design. Identify the terms in ACCESS FM. | [ACCESS FM](http://accessfm.com/)  The design analysis tool  (accessfm.com) | R040  Students will use ACCESS FM and disassembly to analyse a product in this unit.  Revisited later in R038 also. |
| 2 | TA1  Designing processes  1.2 Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach  1.2.1 Design | This lesson could focus on generating design ideas against a design specification forms the second phase of the iterative design cycle – the design phase.  You could:   * introduce students to the key categories included in an engineering design specification, using suitable example specifications to consider. * show them examples of how freehand sketching is used by the designer to quickly generate a range of design ideas. | **Engineering design specification**  **Sketching**  **Modelling** | Explain the key aspects of an engineering design specification and use these to identify the requirements for a product. Explain the purpose of sketching when generating design ideas. | [Design briefs and specifications - Investigating](https://www.bbc.co.uk/bitesize/guides/zbn6pbk/revision/3) - GCSE Design and Technology Revision - BBC Bitesize (bbc.co.uk) | R039  Students will generate design ideas by sketching |
| 3 | TA3  Communicating design outcomes  3.1 Types of drawing used in engineering | In this lesson you could give students further opportunity to investigate the generation of design ideas using freehand sketching:   * they could quickly produce a range of design ideas using freehand sketches for a supplied product design specification and share these with their peers. * they could consider the advantages and limitations of freehand sketching.     Note sketching skills are further developed in greater depth and detail in R039. | **Freehand sketching** | Identify the advantages and limitations of using sketching to generate design ideas. Be able to produce simple sketches. | [Design Sketching Class](https://www.instructables.com/Design-Sketching-Class/) – Instructables craft  (instructables.com) | R039  Students will generate design ideas by sketching |
| 4 | TA3  Communicating design outcomes  3.1 Types of drawing used in engineering | You could introduce students to the following drawing types, using suitable examples:   * isometric * oblique * exploded views * assembly drawings.   You could summarise the key characteristics of each drawing type and explore how each drawing types is useful to the designer to communicate information.  Again, students will gain further practice at using these drawing types in Unit R039. | **Isometric**  **Oblique**  **Exploded views**  **Assembly drawings** | Explain the key characteristics and applications of the following drawing types: isometric, oblique, exploded views, assembly drawings. | [Sketching and annotation - Communication of ideas](https://www.bbc.co.uk/bitesize/guides/zffhsrd/revision/1) - GCSE Design and Technology Revision - BBC Bitesize  (bbc.co.uk) | R039  Students will produce drawings of design ideas |
| 5 | TA3  Communicating design outcomes  3.1 Types of drawing used in engineering | In this final lesson on drawing types, you could show students examples of the following types of drawing:  - block diagrams  - flowcharts  - circuit diagrams  - wiring diagrams.  They could summarise where each type of drawing would be used, and to which aspect of a design or the design process for a product they relate. | **Block diagrams**    **Flowcharts**  **Circuit diagrams**  **Wiring diagrams** | Explain the key characteristics and applications of the following drawing types: block diagrams, flowcharts, circuit diagrams, wiring diagrams. | [Block Diagram - Learn about Block Diagrams](https://www.smartdraw.com/block-diagram/),  See examples (smartdraw.com)  [What is a Flowchart](https://www.lucidchart.com/pages/what-is-a-flowchart-tutorial), (Lucidchart.com)  [Types of Electrical Drawing and Diagrams](https://www.electricaltechnology.org/2020/04/types-electrical-drawing-diagrams.html) (electricaltechnology.org) | R040  Students could use block diagrams and flowcharts for planning to make a prototype |

| Spring 1 | |
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| **Summary of what you  will cover from the curriculum planner:** | **Sketching and drawing, CAD** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3  Communicating design outcomes  3.2 Working drawings | In this lesson about engineering drawing, you could:   * introduce the purpose of engineering drawings as part of the design and manufacturing processes for products * show students a 2D engineering drawing using third angle orthographic projection and the projections and key features identified * show more engineering drawings for products to find out what students can initially interpret from them. | **2D engineering drawings**  **Third angle orthographic projection** | Explain the purpose of a third angle orthographic drawing and what information the drawing shows. | [Working drawings - Designing](https://www.bbc.co.uk/bitesize/guides/zvgvgdm/revision/6) - GCSE Design and Technology Revision - BBC Bitesize (bbc.co.uk) | R039  Students will produce engineering drawings |
| 2 | TA3  Communicating design outcomes  3.2 Working drawings | As a follow on from the previous lesson, you could:   * give students real objects from which to produce basic third angle projection drawings * task them to complete using construction lines third angle orthographic drawings where all views (projections) are not shown. This is further developed in Unit R039. | **2D engineering drawings**  **Third angle orthographic projection** | Be able to complete or produce a simple third angle orthographic drawing. | [Introduction to Orthographic Projection](https://static.sdcpublications.com/multimedia/9781630570521-sample/ege/ortho/ortho_page1.htm) (sdcpublications.com) | R039  Students will produce engineering drawings |
| 3 | TA3  Communicating design outcomes  3.2 Working drawings | To develop engineering drawing further in this lesson, you could include introducing standard drawing conventions:   * title block * metric units of measurement * scale * tolerance.   While engineering drawing is developed in detail in Unit R039, you could show students drawings with drawing conventions and append them to their own drawings. | **Standard drawing conventions** | Illustrate, identify, and explain the following drawing conventions: title block, metric units of measurement, scale, tolerance. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865)  (tes.com)  [note – some resources have download fee] | R039  Students will produce engineering drawings |
| 4 | TA3  Communicating design outcomes  3.2 Working drawings | This lesson looks at the meaning of the key line types used in engineering drawing including:   * outlines * hidden detail * centre line * projection * dimension * leader line.   Students could practise identifying different line types on supplied engineering drawings, and producing simple engineering drawings using the appropriate line types. | **Drawing line types** | Illustrate, identify, and explain the following drawing line types: outlines, hidden detail, centre line, projection, dimension, leader line. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865)  (tes.com)  [note – some resources have download fee] | R039  Students will produce engineering drawings |
| 5 | TA3  Communicating design outcomes  3.2 Working drawings | During this lesson, students could consolidate their understanding of engineering drawing, standard drawing conventions and line types by producing or completing an engineering drawing.  They will have opportunity to further develop their practical drawing skills in Unit R039. | **Drawing practice** | Consolidate knowledge of engineering drawing and drawing conventions learned so far. | [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865)  [note – some resources have download fee] | R039  Students will produce engineering drawings |

| Spring 2 | |
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| **Summary of what you  will cover from the curriculum planner:** | **Sketching and drawing, CAD** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA3  Communicating design outcomes  3.2 Working drawings | This lesson introduces drawing abbreviations:   * across flats * centre line * diameter * drawing * material * square.   You could compile a quiz with drawing examples for students to test their knowledge of these abbreviations. | **Abbreviations (drawings)** | Illustrate, identify, and explain the following drawing abbreviations and conventions: across flats, centre line, diameter, drawing, material, square | [Acronyms and Abbreviations in Engineering](https://blog.draftsperson.net/acronyms-and-abbreviations-in-engineering/) (draftsperson.net) | R039  Students will produce engineering drawings |
| 2 | TA3  Communicating design outcomes  3.2 Working drawings | Finally, you could introduce students to how other mechanical features are represented on engineering drawings:   * threads * holes * chamfers * countersinks * knurls.   Students could practise drawing and explaining each of the features. You could also give out drawings and ask students to identify these mechanical features. | **Mechanical features (on drawings)** | Illustrate, identify, and explain the following mechanical features shown on drawings: threads, holes, chamfers, countersinks, knurls. | [How to use a Knurling Tool](https://technologystudent.com/equip1/knurl1.htm) (technologystudent.com) | R039  Students will produce engineering drawings |
| 3 | TA3  Communicating design outcomes  3.3 Using CAD drawing software | You could set students a research activity for this lesson to find out and summarise the advantages and limitations of using CAD drawing software compared to manual drawing techniques when producing engineering drawings.  They could work in small groups and summarise their findings in a simple presentation to present to the group. | **CAD (advantages and limitations of)** | Summarise the key advantages and limitations of using CAD software in engineering design. | [Advantages and Disadvantages of Using Computer Aided Design (CAD)](https://www.arcvertex.com/article/advantages-and-disadvantages-of-using-computer-aided-design-cad/)  (arcvertex.com) | R039  Students will produce engineering drawings using CAD |
| 4 | TA2  Designing requirements  2.3 Influences on engineering product design | In this lesson, introduce students to the terms market pull and technology push and how they related to the design of new products. You could:   * use suitable example products and case studies of products to illustrate each * hold a discussion asking students discussion to think about other products that have been created because of market pull forces or introduced to the market through technological push. | **Market pull**  **Technology push** | Summarise the terms market pull and technological push, giving example products under each. | [Invention and innovation: an introduction: 12.2 Technology push](https://www.open.edu/openlearn/science-maths-technology/design-innovation/invention-and-innovation-introduction/content-section-11.6.2) - OpenLearn - Open University - T307\_1  (open.edu) |  |
| 5 | TA2  Designing requirements  2.3 Influences on engineering product design | This lesson looks at the importance of considering legislation in relation to the design of new products. It acts as an introduction to the next lesson on standards - so you will need to explain the link between legislation (laws) and standards (which are a way to satisfy legislation practically).  You could:   * explain easily identifiable national and internal legislation relating to product design and product manufacture (e.g. the Health and Safety at Work Act or the Machinery Directive including risk assessment) * explain the different terminology of UK laws and European regulations and directives etc. | **Legislation** | Explain what legislation means, and how it is significant to product design. Relate legislation to standards. | UK law on the design and supply of products - [Work equipment and machinery](https://www.hse.gov.uk/work-equipment-machinery/uk-law-design-supply-products.htm) (hse.gov.uk)  [Managing risks and risk assessment at work – Overview - HSE](https://www.hse.gov.uk/simple-health-safety/risk/index.htm)  (hse.gov.uk) | R040  Students could identify legislation when carrying out a product evaluation |

| Summer 1 | |
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| **Summary of what you  will cover from the curriculum planner:** | **Influences on engineering product design** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2  Designing requirements  2.3 Influences on engineering product design | This lesson follows on from legislation and explains that British and International Standards provide more contextualised guidance on how to comply with legislation. You could:   * explain the purpose of standards including how specific standards are developed and made available for different products and services * use the BSI website to illustrate different standards available * use the UKCA website to explore product conformity assessment and marking. | **British and International Standards** | Explain what British and International Standards are and how they inform product design. Also, their relationship with legislation. | [What is a standard and what does it do?](https://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/)  BSI (bsigroup.com)  [Using the UKCA marking](https://www.gov.uk/guidance/using-the-ukca-marking) (www.gov.uk) | R040  Students could identify Standards when carrying out a product evaluation |
| 2 | TA2  Designing requirements  2.3 Influences on engineering product design | You could start this lesson with a discussion about how long a technological product (such as a mobile phone) is expected to last in the face of changing technology before being replaced.  You could introduce planned obsolescence through further example products, with a class discussion of the design features and decisions that are made to achieve this. | **Planned obsolescence** | Explain what planned obsolescence means, with examples of how this is incorporated into products with examples. | [Planned Obsolescence Sucks. Here's Why It Still Exists](https://www.youtube.com/watch?v=wzWU7D0S9_8) - YouTube  (c.10 min video) | R040  Students could identify planned obsolescence features when carrying out a product evaluation |
| 3 | TA2  Designing requirements  2.3 Influences on engineering product design | You could start this lesson with a basic introduction to sustainable design (6Rs):   * Rethink * Reuse * Recycle * Repair * Reduce * Refuse.   You could explore each of the terms in more detail:   * hold a class discussion to identify how products fit into each * develop a quiz to match the sustainability features of products to each of the terms (e.g. a tin is recycled while a broken-down car can often be repaired). | **Sustainable design (6Rs)** | Explain the terms in the 6Rs, relating them to the design of a product. | [6Rs - Practical Action](https://practicalaction.org/schools/6-rs/)  (practicalaction.org) | R040  Students could identify sustainable design features when carrying out a product evaluation |
| 4 | TA2  Designing requirements  2.3 Influences on engineering product design | You could use online resources to develop a worksheet about design for the circular economy – and how this method is used to design out waste and pollution.  Students could undertake their own research, working in small groups, and present their findings back to the group using a short presentation or poster. | **Design for the circular economy** | Explain what is meant by the circular economy and how it is important to the design of products. | [Circular Design](https://www.ellenmacarthurfoundation.org/explore/circular-design) (ellenmacarthurfoundation.org) |  |
| 5 | TA1  Designing processes  1.2.2 Make and evaluate | In this lesson, students return to the next phase of the iterative design cycle and to the optimise phase in which prototypes are made and evaluated.  You could:   * introduce students to the reasons for modelling: * to test proportions * to test scale * to test function * use case study product examples to illustrate each of these different reasons for modelling. | **Modelling (reasons for)** | Explain why the designer will produce models of products – to test proportions, to test scale, to test function. Explain each of these criteria. | [Modelling – Designing](https://www.bbc.co.uk/bitesize/guides/z6jkw6f/revision/9)  GCSE Design and Technology Revision, BBC Bitesize (bbc.co.uk) | R040  Students could apply knowledge of reasons for modelling when making a prototype |

| Summer 2 | |
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| **Summary of what you  will cover from the curriculum planner:** | **Make and modelling; virtual and physical prototypes** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA1  Designing processes  1.2.2 Make and evaluate | The following series of lessons complement virtual and physical prototypes that students will produce in Unit R040.  In this lesson, you could:   * introduce the purpose and reasons for virtual and physical modelling and evaluation of design ideas * show examples of virtual and physical models and prototypes to students to discuss and evaluate, including the benefits and drawbacks of both types of modelling as part of the design process. | **Virtual and physical modelling** | Summarise the difference between virtual and physical modelling. Give reasons why each method is used. | [Real World: From Idea to Physical Prototype](https://www.youtube.com/watch?app=desktop&v=r-ToqI1KUYg) – YouTube (c. 3 minute video)  [How McLaren Automotive uses virtual reality to design its sportscars and supercars](https://www.youtube.com/watch?app=desktop&v=mWaQfjEJIMQ)  YouTube (c. 2 minute video) | R040  Students will produce a virtual and physical prototype |
| 2 | TA4  Evaluating design ideas  4.2 Modelling methods | In this lesson, you could cover virtual modelling and prototyping using 3D CAD software in more detail:   * explore the advantages and drawbacks of the method could be explored more deeply * look at the key design requirement that virtual modelling can address * show example 3D CAD models to students to illustrate visualisation and study of the interface and motion of component. | **Virtual (3D CAD)** | Summarise the key features of virtual modelling, including its relative advantages and drawbacks to the designer. | [The Future of Design](https://www.youtube.com/watch?app=desktop&v=xNqs_S-zEBY)  YouTube (c. 4 minute video) | R040  Students will produce a virtual prototype |
| 3 | TA4  Evaluating design ideas  4.2 Modelling methods | In this lesson, you could start to introduce students to methods for creating a physical model, beginning with the use of sheet materials (such as card) and block materials (such as foam or wood). You could task students to:   * explore the information that can be obtained by modelling using different methods, and what tools and equipment is required to process each type of material to make a model * investigate and summarise the advantages and limitations of modelling with different materials.   You could include further types of modelling materials (e.g. sheet materials other than card, and further block materials). | **Card**  **Block** | Explain how card and block can be used to produce physical models, and what information can be obtained from the model. Summarise the advantages and limitations of different modelling methods using these materials. | [Students of Product Design Series](https://www.youtube.com/playlist?app=desktop&list=PLEefXt0jkKvxG457mIvNSMip6pwuUn_T8)  YouTube  (variety of resources) | R040  Students will select materials and methods for making a physical prototype |
| 4 | TA4  Evaluating design ideas  4.2 Modelling methods | This session could cover different methods of modelling and prototyping in this session including breadboarding (typically used for circuit construction) and 3D printing.  You could:   * task students to research how breadboards work, and the key stages of producing a 3D printed model (from CAD design through to printing). * explore different methods of 3D printing. | **Breadboarding**  **3D printing** | Identify where breadboarding and 3D printing would be used for modelling. Summarise the key characteristics, advantages and limitations of each method. | [How to Use a Breadboard](https://www.youtube.com/watch?v=6WReFkfrUIk)  YouTube (c. 12 minute video)  [3D Printing Basics! (Ep1)](https://www.youtube.com/watch?app=desktop&v=nb-Bzf4nQdE) – YouTube (c. 11 minute video) | R040  Students will select materials and methods for making a physical prototype |
| 5 | TA1  Designing processes  1.2.2 Make and evaluate | In this final lesson on modelling, students could discuss how a prototype is used to inform the iterative design process, and the purpose of comparison of the model or prototype against the requirements of the design brief and specification.  You could:   * explore the reasons for producing more than one prototype and why it is often necessary to modify the prototype following evaluation * use example product prototypes to illustrate this. | **Prototyping** | Explain how modelling informs the iterative design process, and how and why comparison of the prototype against the original design brief/specification happens. | [How to write a ‘Product Design Specification’](http://www.3minds.co.uk/blog/?p=109)  3Minds Limited Blog | R040  Students will produce and review prototypes against specification |

Second year of teaching

| Autumn 1 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Design considerations; user needs and manufacturing requirements** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2  Design requirements  2.1 Types of criteria included in an engineering design specification | This lesson looks at needs and wants,  Criteria included in a design specification often includes the needs and wants of the customer, end user, manufacturer, and others.  You could:   * explain the difference between need and wants * use example design specifications or products to discuss with students the needs and wants of different stakeholders. | **Needs and wants** | Explain the difference between needs and wants, and how they relate to the design of a product. | [Differences between needs and wants / needs vs wants 2021](https://www.youtube.com/watch?app=desktop&v=NTB2LRq-n9I)  YouTube (c. 2 minute video) |  |
| 2 | TA2  Design requirements  2.1 Types of criteria included in an engineering design specification | You could start the lesson by explaining the difference between quantitative and qualitative criteria within a design specification, using examples.  Students may already be familiar with qualitative and quantitative data from study of research methods so you could:   * use a sample design specification to illustrate both criteria * give students a quiz in which they identify whether criteria is quantitative or qualitative. | **Quantitative and qualitative criteria** | Explain and identify the differences between quantitative and qualitative criteria.  Give examples of each type. | [Qualitative and Quantitative Data](https://www.youtube.com/watch?v=dwFsRZv4oHA)  YouTube (2 minute video) | R040  Students will use primary and secondary research to evaluate a product |
| 3 | TA2  Design requirements  2.1 Types of criteria included in an engineering design specification | In this lesson students return to the ACCESS FM approach in the context of the design specification. You could:   * start the lesson with a recap of the approach * give students an engineering produce design specification and ask them to analyse it, identifying the product requirements under each of the key ACCESS FM headings. | **ACCESS FM** | Use ACCESS FM to analyse a supplied engineering product design specification. | [ACCESS FM](http://accessfm.com/)  The design analysis tool  (accessfm.com) | R040  Students will use ACCESS FM to evaluate a product |
| 4 | TA2  Design requirements  2.1 Types of criteria included in an engineering design specification | As a follow on, in this lesson, you could:   * ask students in small groups to produce an engineering product design specification using the ACCESS FM approach * could give them a product scenario for this lesson and feedback their completed specification to the whole group.   Note, students will build into using ACCESS FM to analyse existing products in Unit R040. | **ACCESS FM Activity** | Use ACCESS FM to analyse a product. | [ACCESS FM](http://accessfm.com/)  The design analysis tool  (accessfm.com) | R040  Students will use ACCESS FM to evaluate a product |
| 5 | TA2  Design requirements  2.2 How manufacturing considerations affect design | This lesson will involve a brief introduction to manufacturing requirements.  You could:   * start the less one by introducing students to different scales of manufacture - one-off, batch, mass production * include the advantages and disadvantages of each and the types of product it is most suitable for * alternatively you could task students to research these manufacturing methods themselves, and summarise their findings. | **Scale of manufacture** | Explain scales of manufacture, including the relative advantages and disadvantages of each, and identify products that are typically manufactured under each - one-off, batch, mass production. | [Scales of production](https://www.stem.org.uk/resources/collection/443805/scales-production)  STEM Learning (stem.org.uk) | R040  Students will analyse a disassembled product – production methods |

| Autumn 2 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Evaluating design ideas and outcomes** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA4  Evaluating design ideas  4.1 Methods of evaluating design ideas | The following series of lessons complement product research activities that students will undertake in Unit R040.  You could:   * start the lesson with a quick summary of the purpose and methods of producing models * also cover how models are compared with the original engineering design brief and specification (both qualitatively and quantitatively) * task students with analysing analyse supplied product examples qualitatively against a design brief, summarising their findings. | **Qualitative comparison with the design brief and specification** | Recall the difference between qualitative and quantitative criteria and be able to qualitatively analyse a product against a design brief. | [Qualitative and Quantitative Data](https://www.youtube.com/watch?v=dwFsRZv4oHA)  YouTube (2 minute video)  [How to write a specification](https://technologystudent.com/designpro/spec1.htm) (technologystudent.com)  [Writing an evaluation](https://technologystudent.com/designpro/eval1.htm) (product)  (technologystudent.com) | R040  Students will make a prototype and compare with supplied design/ brief specification |
| 2 | TA4  Evaluating design ideas  4.1 Methods of evaluating design ideas | In this lesson, you could introduce students to the use of ranking matrices when analysing products.  Students could construct ranking matrices, and use visual methods (graphs, charts etc.) to compare product rankings – possibly using a spreadsheet program.  Note, students will further use ranking matrices in Unit R040 when undertaking product analysis. | **Ranking matrices** | Explain why and how ranking matrices are produced and why they are useful to the designer; produce a simple ranking matrix. | [8+ Product Comparison Templates Excel](https://www.getexceltemplates.com/product-comparison-template-excel.html)  Excel Templates (getexceltemplates.com) | R040  Students could use a ranking matrix to compare products |
| 3 | TA4  Evaluating design ideas  4.1 Methods of evaluating design ideas | In this lesson, you could introduce Quality Function Deployment (QFD).  You could:   * start with a brief overview of the purpose of QFD * use an example to show how a QFD ‘house of quality’ is constructed and what it shows to the designer. | **Quality Function Deployment (QFD)** | Explain the term QFD, and summarise briefly the purpose of a QFD matrix and the stages involved in its construction. | [How to Build a House of Quality (QFD)](https://www.lucidchart.com/blog/qfd-house-of-quality)  Lucidchart Blog  (lucidchart.com) | R040  Students could use QFD to compare products |
| 4 | TA4  Evaluating design ideas  4.3 Methods of evaluating a design outcome | In this lesson, students will continue to investigate methods of evaluating design outcomes by looking at methods of measuring the dimensions and functionality of the product.  You could:   * show them different measuring instruments (e.g. steel rule, Vernier callipers, micrometres etc) and practise using them to measure the key dimensions of a supplied model * task them with performing perform functional testing of a supplied model to confirm that it works as expected * ask them to identify and discuss the advantages and limitations of each method. | **Measuring dimensions**  **Functionality** | Explain methods used to evaluate a design outcome by taking measurements using different measuring instruments, and through functional testing. Summarise the advantages and limitations of each method. | [Top-10 Mechanical Measuring Instruments](https://gaugehow.com/2019/05/26/mechanical-measuring-instruments/)  GaugeHow  (gaugehow.com) | R040  Students will compare a prototype against a product design specification |
| 5 | TA4  Evaluating design ideas  4.3 Methods of evaluating a design outcome | In this lesson, you could:   * show students how to use information and data obtained from taking measurements and testing the functionality of a model to make a quantitative comparison of the model with the design brief and specification * ask them to tabulate their results and produce a reasoned comparison * supply models and design briefs, some with inconsistencies and errors in the model for students to discover and comment on. | **Design brief and specification (quantitative comparison)** | Explain how quantitative data (from testing and measurement) of a model is compared against the product design brief. | [Qualitative and Quantitative Data](https://www.youtube.com/watch?v=dwFsRZv4oHA)  YouTube (2 minute video)  [How to write a specification](https://technologystudent.com/designpro/spec1.htm) (technologystudent.com)  [Writing an evaluation](https://technologystudent.com/designpro/eval1.htm) (product)  (technologystudent.com) | R040  Students will compare a prototype against a product design specification |

| Spring 1 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Design considerations; user needs and manufacturing requirements** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA4  Evaluating design ideas  4.3 Methods of evaluating a design outcome | In this lesson, you could introduce students to user testing of products, including its advantages and limitations.  You could:   * relate this initially to commercial products * ask student to practise in small groups user testing of simple supplied products * ask them to summarise and present their findings to the group. | **User testing** | Explain the term user testing, with examples. | [Innovation 101 E4: Prototyping & Testing - Physical Products](https://www.youtube.com/watch?app=desktop&v=2PzT0aAi9Lw)  YouTube (c. 4 minute video) | R040  Students will compare a prototype against a product design specification |
| 2 | TA4  Evaluating design ideas  4.3 Methods of evaluating a design outcome | This lesson looks at the reasons for identifying potential modifications and improvements to the design.  You could:   * give students case studies of products to review * hold a class discussion to identify and justify potential improvements to the design of the product. | **Design modifications and improvements** | Give reasons for design modifications and improvements when evaluating design outcomes. | [Form Follows Function: Tips to Improve Your Product Designs](https://www.youtube.com/watch?v=WhKMx5sZ-Zg) YouTube (c. 6 minute video) | R040  Students will identify potential improvements in a design |
| 3 | TA2  Design requirements  2.2 How manufacturing considerations affect design | The final series of lessons focuses on each of the manufacturing processes in detail.  In the first lesson, you could:   * introduce students to wasting, along with examples of how the process is carried out * if possible include practical demonstrations or videos of different wasting processes * ask students to summarise the advantages and limitations of wasting to the designer. | **Wasting** | Explain the term wasting, with examples of how this process is carried out. Identify wasting processes from supplied examples. | [Manufacturing Processes](https://bournetoinvent.com/index.php/27-design-engineering-theory-topics/120-5-6-manufacturing-techniques) (bournetoinvent.com)  [Modern High Speed CNC Lathe Machine Working, CNC Milling Machine Metal](https://www.youtube.com/watch?v=jF4F8Zr2YO8) YouTube (c. 13 minute video) | R040  Students will analyse a disassembled product – production methods |
| 4 | TA2  Design requirements  2.2 How manufacturing considerations affect design | This lesson introduces shaping and forming processes.  Again, you could include practical demonstrations or online videos shown as an alternative. | **Shaping**  **Forming** | Explain the terms shaping and forming, with examples of how this process is carried out. Identify shaping and forming processes from supplied examples. | [Extreme Fast Milling Machines in Action - DATRON CNC Machines](https://www.youtube.com/watch?v=osqX7iQEnuI)  YouTube (c. 12 minute video)  [Press Brake Metal Bending Crash Course](https://www.youtube.com/watch?app=desktop&v=73QtcoXrHb4)  YouTube (c. 12 minute video) | R040  Students will analyse a disassembled product – production methods |
| 5 | TA2  Design requirements  2.2 How manufacturing considerations affect design | You could cover joining and assembly methods in this lesson – both permanent and temporary fixing methods:   * summarise the advantages of both methods and relate them to the design, manufacture, and maintenance of the product * discuss examples of different joining methods including more complex permanent methods such as soldering, brazing, and welding * again, use practical demonstrations or videos. | **Joining** | Explain the term joining, with examples of how this process is carried out. Identify joining processes from supplied examples. | [Joining methods - Metals](https://www.bbc.co.uk/bitesize/guides/zn2w7p3/revision/9) GCSE Design and Technology Revision  BBC Bitesize  (bbc.co.uk)  [Difference Between Temporary Joining and Permanent Joining](http://www.differencebox.com/engineering/difference-between-temporary-joining-and-permanent-joining/) (differencebox.com) | R040  Students will analyse a disassembled product – joining/ assembly methods |

| Spring 2 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Design considerations; user needs and manufacturing requirements**  **Examination revision (revision of Topic Areas) and preparation** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | TA2  Design requirements  2.2 How manufacturing considerations affect design | In this lesson, you could:   * cover finishing methods such as deburring sharp edges, applying coatings and finishes such as paint and final product cleaning operations * use a video(s) to show finishing operations taking place. | **Finishing**  **Assembly** | Explain the terms finishing and assembly, with examples of how this process is carried out. Identify finishing and assembly processes from supplied examples. | [CMA Robotics Spa - Automotive painting](https://www.youtube.com/watch?app=desktop&v=gUWCljX7oa0) YouTube (c. 10 minute video) | R040  Students will analyse a disassembled product – assembly methods |
| 2 | TA2  Design requirements  2.2 How manufacturing considerations affect design | In this final lesson on manufacturing, covering production costs (labour and capital cost), you could:   * explain the different types of costs associated with the production of a product * show simple example calculations * task students with practising calculating the overall manufacturing cost of a product based on labour and capital costs or work out selling price for a given profit * use a spreadsheet program to show and manipulate and present (as tables and graphs) production cost calculations. | **Production costs**    **Labour**  **Capital cost** | Explain the terms production and capital costs, and how these determine the manufacturing cost of a product. Be able to solve simple production cost problems. | [Labour and capital - Methods of production](https://www.bbc.co.uk/bitesize/guides/zth78mn/revision/5) National 5 Business management Revision - BBC Bitesize (bbc.co.uk)  [Cost of production with the example of calculation in Excel](https://exceltable.com/en/formulas-ranges/cost-production-calculation) (exceltable.com) |  |
| 3 | Revision TA1 | The final series of lessons covers revision of the topics across the topic areas.  You could use worksheets and quizzes to test student knowledge and understanding across selected topics from each area.  The first revision session covers the key features and stages involved with different design strategies:   * linear design * inclusive design * user-centred design * sustainable design * ergonomic design. | Revision TA1 | Recall the key pointes relating to different design strategies, including the stages involved with each. | [What is inclusive design?](http://www.inclusivedesigntoolkit.com/)  University of Cambridge (inclusivedesigntool.kit.com)  [Human-centred design explained with examples](https://uxdesign.cc/human-centered-design-explained-with-examples-707133acf8b4) by Cibin KS, UX Collective  (uxdesign.cc)  [Great examples of sustainable design](https://turbofuture.com/industrial/Great-Examples-of-Sustainable-Design), T McNerney, Turbofuture  (turbofuture.com)  [12 Awesome examples of ergonomic product design](https://www.cadcrowd.com/blog/12-awesome-examples-of-ergonomic-product-design/), P Skidmore, cad crowd  (cadcrowd.com) |  |
| 4 | Revision TA1 | This revision session could cover iterative design in more details, and the key elements of each of its stages through design, make and evaluation. | Revision TA1 | Recall the key stages of the iterative design process, and the operations carried out in each stage. | [Iterative design process – Design strategies](https://www.bbc.co.uk/bitesize/guides/zjjkw6f/revision/4), GCSE Design and Technology, BBC Bitesize (bbc.co.uk)  [Design briefs and specifications - Investigating](https://www.bbc.co.uk/bitesize/guides/zbn6pbk/revision/3) - GCSE Design and Technology Revision - BBC Bitesize  (bbc.co.uk |  |
| 5 | Revision TA3 | In this revision session you could use worksheets to recap on the different types of drawings used in engineering. | Revision TA3 | Recall the different types of engineering drawings used. | [Design Sketching Class](https://www.instructables.com/Design-Sketching-Class/)  (instructables.com)  [Sketching and annotation - Communication of ideas](https://www.bbc.co.uk/bitesize/guides/zffhsrd/revision/1) - GCSE Design and Technology Revision - BBC Bitesize (bbc.org.uk)  [Block Diagram - Learn about Block Diagrams](https://www.smartdraw.com/block-diagram/),  (smartdraw.com)  [What is a Flowchart](https://www.lucidchart.com/pages/what-is-a-flowchart-tutorial)  (lucidchart.com)  [Types of Electrical Drawing and Diagrams](https://www.electricaltechnology.org/2020/04/types-electrical-drawing-diagrams.html) (electricaltechnology.org) |  |

| Summer 1 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Examination revision (revision of Topic Areas)** |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Revision TA3 | The focus of this revision session could be working drawings – orthographic engineering drawings, drawing conventions. Students could complete a worksheet with an orthographic drawing. | Revision TA3 | Recall the key features of engineering orthographic drawings. | [Working drawings - Designing](https://www.bbc.co.uk/bitesize/guides/zvgvgdm/revision/6) - GCSE Design and Technology Revision - BBC Bitesize (bbc.org.uk)  [TES Engineering Drawing resource](https://www.tes.com/teaching-resource/engineering-drawing-resource-11420865) (tes.com)  [note – some resources have download fee] |  |
| 2 | Revision TA2 | This revision lesson could cover:   * the criteria used in engineering design specifications (excluding manufacturing which was covered in detail in the final set of taught lessons) * needs and wants * qualitative and quantitative criteria * a recap of ACCESS FM. | Revision TA2 | Recall the terms needs and wants, qualitative and quantitative criteria and a recap ACCESS FM. | [Differences between needs and wants/needs vs wants 2021](https://www.youtube.com/watch?app=desktop&v=NTB2LRq-n9I)  YouTube (c. 2 minute video)  [Qualitative and Quantitative Data](https://www.youtube.com/watch?v=dwFsRZv4oHA)  YouTube (2 minute video)  [ACCESS FM](http://accessfm.com/)  The design analysis tool  (accessfm.com) |  |
| 3 | Revision TA2 | This session could over revision of the influences on engineering design:   * market pull * technological push * legislation and standards * planned obsolescence * sustainable design and the circular economy. | Revision TA2 | Recall the terms market pull, technological push, legislation and standards, planned obsolescence and sustainable design and the circular economy. | [Invention and innovation: an introduction: 12.2 Technology push](https://www.open.edu/openlearn/science-maths-technology/design-innovation/invention-and-innovation-introduction/content-section-11.6.2) – Invention and Innovation - OpenLearn (open.edu)  [UK law on the design and supply of products - Work equipment and machinery](https://www.hse.gov.uk/work-equipment-machinery/uk-law-design-supply-products.htm) (hse.gov.uk)  [Planned Obsolescence Sucks. Here's Why It Still Exists](https://www.youtube.com/watch?v=wzWU7D0S9_8) - YouTube  (c.10 min video)  [6Rs - Practical Action](https://practicalaction.org/schools/6-rs/)  (practicalaction.org) |  |
| 4 | Revision TA4 | This lesson could cover revision of the methods of evaluating design ideas including:   * production of models * qualitative comparison with the design brief * ranking matrices * QFD. | Revision TA4 | Recall the purpose of the production of models, qualitative comparison with the design brief, ranking matrices and QFD. | Modelling – [Designing](https://www.bbc.co.uk/bitesize/guides/z6jkw6f/revision/9)  GCSE Design and Technology Revision, BBC Bitesize (bbc.co.uk)  [Students of Product Design Series](https://www.youtube.com/playlist?app=desktop&list=PLEefXt0jkKvxG457mIvNSMip6pwuUn_T8)  YouTube  (variety of resources) |  |
| 5 | Revision TA4 | In this final revision session you could revisit modelling methods and methods of evaluating design including:   * measuring equipment and its use * quantitative comparison against the design brief * user testing * reasons for product modifications. | Revision TA4 | Recall how measuring equipment is used, quantitative comparison against the design brief, user testing and reasons for product modifications. | [Top-10 Mechanical Measuring Instruments](https://gaugehow.com/2019/05/26/mechanical-measuring-instruments/)  (Gaugehow.com)  [Writing an evaluation](https://technologystudent.com/designpro/eval1.htm)  (technologystudent.com)  [Form Follows Function: Tips to Improve Your Product Designs](https://www.youtube.com/watch?v=WhKMx5sZ-Zg) YouTube (c. 6 minute video) |  |

| Summer 2 | |
| --- | --- |
| **Summary of what you  will cover from the curriculum planner:** | **Examination revision (practice questions)** Note: this could occur in parallel with revision work of Summer 1. |

| Lesson no. | Topic areas/sub topic areas | Lesson ideas and activities | Lesson keywords | Lesson outcome(s)  At the end of the lesson, students will be able to: | Useful links/resources | How does this link to other units? |
| --- | --- | --- | --- | --- | --- | --- |
| 1 onwards | Exam revision | You could reserve the final series of lessons for examination revision using practice questions:   * give students different types and styles of questions to practise answering, including short and long answer questions * show students how to analyse and decompose the requirements of question, including how command verbs are used * show how marks are allocated across questions, and what is required to achieve the marks indicated on the exam paper: * get students to attempt questions, peer mark others’ answers and discuss. | Exam revision | Analyse and practise exam style questions. Be able to provide responses to a selection of different types of exam question.  Use teacher and peer review to inform further revision. | [OCR’s guide to understanding the assessment – examined and moderated](https://www.ocr.org.uk/Images/612302-understanding-the-assessment-examined-and-moderated.pdf):  - p 9 command words  - pp 12-18 exam question types  (ocr.org.uk) |  |

## Teaching over three years

Some centres may choose to start their delivery of the qualification earlier in Year 9, and so deliver over three years. The following topic areas are suggestions of what could form part of early delivery.

|  |  |  |
| --- | --- | --- |
| Topic area | Warm up/introductory activities | Length of time activity may take |
| TA1  Designing processes  1.1 The stages involved in design strategies | Students could start to become familiar with different types of design strategy available to the designer. You could explore examples of each strategy with them, with an emphasis on iterative design. Students could design a poster highlighting key features of each of the design strategies. | 5-6 hours with additional time for working in small groups to create a poster. |
| TA3  Communicating design outcomes  3.1 Types of drawing used in engineering | You could show students different types of engineering drawing and diagrams, and how they communicate different information. They could practise developing a design idea using a series of sketches and suggest how the design can be taken forward through the rest of the design cycle. | 4-5 hours with additional time to practise producing a series of sketches plus compiling suggestions for how to take designs through next stages of the iterative design cycle. |
| TA3  Communicating design outcomes  3.2 Working drawings | Students could become familiar with working drawings, and the conventions and terminology used within them. They could practise producing third angle orthographic drawings for a range of objects and products. This will also be useful for Unit R039. | 4-5 hours with additional time to practise producing third angle orthographic drawings. |
| TA3  Communicating design outcomes  3.3 Using CAD drawing software | Students could start to develop their skills at using CAD software. This will also be useful for Units R039 and R040. They could develop a presentation showing how CAD can be used to model and test a product (a virtual prototype) and summarise the advantages and disadvantages of using CAD compared to sketching and producing working drawings by hand. | 6-7 hours to learn basics of CAD software with additional time to learn more advanced features and to produce simple CAD models and produce a presentation. |

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