2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

# ENGINEERING

## Unit 10

## Computer Aided Design (CAD)

**T/506/7276**

**Guided learning hours: 60**

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

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# LEVEL 3

# UNIT 10: COMPUTER AIDED DESIGN (CAD)

# T/506/7276

## Guided learning hours: 60

## Essential resources required for this unit: Computer Aided Design (CAD) software

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

## UNIT AIM

Computer aided design (CAD) has been used across the world for many years in many diverse industries to design products, including both mechanical and electrical component and product design.  A variety of software packages are used to perform this commercially.

The aim of this unit is for learners to develop the ability to be able to produce 3D models using CAD, and to go onto create 3D assemblies of components within a CAD system.

To underpin this, learners will develop the skill of producing 2D CAD engineering drawings to appropriate standards, and will develop knowledge and understanding of the use of simulation tools within commercial CAD systems.

## 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. Be able to produce 3D models using Computer Aided Design (CAD) | 1.1 how to use solid modelling tools to produce 3D models<br>• sketch-based features i.e.<br>o sketch tools i.e.<br>o lines, arcs, splines, polygons (e.g. rectangles, hexagons)<br>o extrudes, revolves<br>o sizing and dimensioning<br>o applied features i.e. fillets, chamfers, shelling, holes, drafts<br>• reference geometry i.e. work planes, axes, points, co-ordinate systems<br>• pattern features i.e. mirror, linear and circular arrays/patterns<br>1.2 how to use advanced solid modelling tools i.e.:<br>• features i.e.<br>o swept features<br>o lofted/blended features<br>o variable section features (e.g. creating loft/blend or swept features with multiple sections)<br>o helical sweeps (e.g. springs, coils or thread geometry)<br>o sheet metal (e.g. folds, pressings, flattened geometry)<br>• projected or intersection geometry i.e.<br>o projected curves or sketches<br>o intersection curves<br>o curves through XYZ or reference points<br>• configurations and table driven features e.g.<br>o configured parts and product families<br>o component geometry driven through formulas and tables<br>• surface modelling i.e.<br>o surface construction geometry e.g. curves, splines<br>o extruded, revolved, swept and lofted/blended surfaces<br>o boundary surfaces, planar/flat or filled surfaces<br>o advanced curve geometry e.g. guide curves, intersection curves, projected geometry |

| Learning Outcomes | Teaching Content |
|---|---|
| **The Learner will:** | **Learners must be taught:** |
| 2. Be able to create 3D assemblies of components within a CAD system | 2.1 aspects of assembly i.e.<br>• multiple component assemblies<br>• patterning components<br>• in-context modelling i.e. creating model geometry within an assembly<br>• exploded views<br>• animation<br>• how to apply constraints or mates (e.g. coincident, parallel, tangent, offset, symmetric)<br>• standard parts (e.g. nuts, bolts, screws and fixings, motors, bearings)<br>2.2 automatic population of assemblies based on geometry (e.g. automatically adding bolts to standard hole specifications) |
| 3. Be able to produce 2D CAD engineering drawings | 3.1 how to use formats and templates i.e.<br>• border templates<br>• formats<br>• standards<br>• critical information<br>3.2 how to use projection and units i.e.<br>• first and third angle projection<br>• section views<br>• detailed views<br>• auxiliary views<br>• isometric views<br>• scale<br>3.3 how to apply dimensioning and annotations i.e.<br>• dimensioning styles e.g. linear, polar, baseline<br>• manufacturing information e.g. surface finish, weld symbols, fit and tolerances<br>3.4 assembly drawings i.e.<br>• tables and balloons<br>o Bill of Materials (BOM)<br>o parts lists<br>o use of standard parts<br>• views i.e.<br>o exploded views<br>o sub-assemblies<br>3.5 drawing standards(e.g. current British Standards e.g. BSI – BS 8888:2011; ISO, ANSI) |

| Learning outcomes | Teaching content |
|---|---|
| **The Learner will:** | **Learners must be taught:** |
| 4. Understand the use of simulation tools within CAD systems | 4.1 types of simulation i.e.<br>• motion i.e.<br>o movement of assemblies<br>o collision detection<br>o gears, drives, motors or pulleys<br>4.2 manufacturability i.e.<br>• draft analysis<br>• mould flow<br>• tooling production<br>• shrinkage allowance<br>• machining simulation<br>• jig and fixture development<br>4.3 Finite Element Analysis (FEA) i.e.<br>• pressure testing<br>• loads/forces applied to components<br>• torsional testing of components<br>• meshing of geometry<br>4.4 Computational Fluid Dynamics (CFD) e.g.<br>• mould flow<br>• material flow<br>• thermal conductivity<br>• fluid flow<br>• aerodynamic efficiency |

## 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. Be able to produce 3D models using Computer Aided Design (CAD) | P1:<br>Use sketch-based features to create geometry. | M1:<br>Use features, projected or intersection geometry and configuration and table-driven features to create geometry. | D1:<br>Use surface modelling techniques to enhance a 3D model. |
| | P2:<br>Use applied and pattern features to create solid models. | | |
| | P3:<br>Use mathematical calculation to solve reference geometry problems for use within the production of CAD models.<br>**Synoptic assessment of Unit 1 Mathematics for Engineering* | | |
| 2. Be able to create 3D assemblies of components within a CAD system | P4:<br>Create CAD assemblies with multiple components. | M2:<br>Create exploded views and animations of 3D CAD assemblies. | |
| | P5:<br>Apply constraints within assemblies that appropriately define the position or movement of the model. | | |

| LO | Pass | Merit | Distinction |
|---|---|---|---|
| 3. Be able to produce 2D CAD engineering drawings | P6:<br>Create a range of views within 2D engineering drawings. | M3:<br>Create detailed engineering drawings of assemblies. | D2:<br>Create engineering drawings which conform to British or International Standards. |
| | P7:<br>Create 2D engineering drawings that include appropriate dimensions and annotations. | | |
| 4. Understand the use of simulation tools within CAD systems | P8:<br>Explain how simulation tools are used in the design of engineering components, products or systems. | M4:<br>Assess the advantages and disadvantages of using simulation tools to assist engineering design. | |

## *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: Be able to produce 3D models using Computer Aided Design (CAD)
Learners should use Computer Aided Design (CAD) software to produce 3D models to an increasing level of complexity (from P1-P3 through M1 to D1). Teachers might supply suitable example activities for learners to model using CAD software. For P3 learners should apply mathematics in order to solve problems involving geometry.

LO2: Be able to create 3D assemblies of components within a CAD system
Learners should be able to use CAD software to produce assemblies comprising multiple components. For M2 exploded views and animations are required, which most CAD software can accommodate. Teachers might provide suitable activities for learners to model using CAD software.

LO3: Be able to produce two-dimensional engineering drawings
Learners should be able to produce 2D drawings to British or International standards in a CAD system. Teachers might supply suitable examples for learners to use whereby they can demonstrate a range of drawing skills. Most CAD software packages allow the production of both 2D and 3D drawings.

LO4: Understand the use of simulation tools within CAD systems
Learners should be able to explain and assess how CAD software might be used to perform simulation (e.g. motion analysis, finite element analysis, computational fluid dynamics). It is not required for learners to perform simulation using CAD software for this LO, which is considered in detail in another unit. Basic simulation could however be performed using suitable examples if desired.

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 (this unit is a mandatory unit in the Mechanical Engineering and Design pathway).

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. | • Students undertake work placements in engineering or manufacturing businesses where Computer Aided Design (CAD) tools are used. Students should have structured time to actively utilise the software in line with industrial practice, in a way which aligns with skills/techniques required in this unit. |
| 2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s). | • Project set on product design or redesign of components, using industry standard CAD equipment and design standards, to determine if the students' design of a product is capable of manufacture. (D/PFMEA, FEA) |
| 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. | • Lecture from practicing CAD engineers involved in product design, development and testing. Content to include examples of CAD software, design principles, CAD drawing standards and working documentation within professional commercial engineering practice.<br>• Employers deliver sessions that showcase the link across skills and units. This may include the link between Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) units or Computer Aided Design (CAD) and Mechanical Simulation and Modelling. |

| Meaningful employer engagement | Suggestion/ideas for centres when delivering this unit |
|---|---|
| 4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a student'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. | • Review from practicing CAD engineers relating to the clarity of CAD engineering drawings and correct identification of design principles used during students' CAD project work and related documentation/software outputs. |

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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