Unit 17: CAD and CAM (LEVEL 2)

Learning outcomes

Candidates will develop a knowledge and understanding of how CAD and CAM are used to design and manufacture a range of products and components.

Candidates will be able to:

- use different CAD tools to produce a range of diagrams and images
- produce CAD drawings with all the information needed for products to be manufactured
- understand how CAD drawings can be converted to provide data for CAM machines
- produce CAD drawings that model 3 dimensional objects before production
- explain the stages of manufacturing from CAD drawing to finished component using CAM
- explain the commercial application of CAD and CAM.

It is anticipated that a candidate will require 60 guided learning hours to complete this unit.

Assessment objectives	Knowledge, understanding and skills
1 Use CAD tools to produce a range of diagrams and images	Produce **three** CAD drawings to include: • images and diagrams • repeat patterns or tessellations • signs and symbols • text • logos
2 Use CAD to produce a card package that could be used by a computer controlled card cutting machine	Produce the net/development for a small card package (intended for containing small items) showing: • accurate cut and score lines • gluing/fastening provision • text and images for one surface/face
3 Use CAD to produce diagrams that contain all the information needed for the manufacture of components and/or products	Create **two** working drawings showing eg: • isometric projection • orthographic projection • scaling • dimensioning • annotation relating to materials and production
4 Use CAD as a 3 dimensional modelling tool	Create a 3 dimensional CAD graphic showing: • an object, product or component • the use of rendering • views of the object from different positions
5 Develop the design for a product or component to be manufactured using a CAM machine	Produce a detailed CAD design drawing for an item that is to be manufactured using a CAM machine and showing: • information on what the item is and what it is to be used for • accurate construction of the drawing • overall dimensions • notes on material choice • notes on proposed manufacture

Assessment objectives	Knowledge, understanding and skills
6 Explain the stages of manufacturing from CAD drawing to finished component using CAM	Report on the CAM production of the designed part showing eg: • information on what the part is and what it is to be used for • how data is transferred to the machine • details of the machine used • how the machine is set up • how the material is fixed into the machine • how the machine is operated • safety features and requirements • alternative methods of production
7 Explain how components are commercially produced in quantity using CAM machines	Case study of a component produced in industry using CAM machinery showing eg: • what the part is • where it is to be used • material to be used • how it is produced • details of the machine to be used • speed of manufacture • alternative methods of production

Assessment

This unit is centre assessed and externally moderated.

In order to achieve this unit, candidates must produce a portfolio of evidence showing that they have met all of the assessment objectives.

Portfolios of work must be produced independently. They will need to be made available, together with witness statements and any other supporting documentation, to the OCR Visiting Moderator when required.

Centres must confirm to OCR that the evidence produced by candidates is authentic. An OCR Centre Authentication Form is provided in the Centre Handbook and includes a declaration for assessors to sign. It is a requirement of the QCA Common Criteria for all Qualifications that proof of authentication is received.

Guidance on assessment and evidence requirements

Centres may wish to organise a link with a local business that use CAD and CAM in their manufacturing. This would be particularly useful for the research into relevant industrial applications.

Candidates are **not** expected to produce a machined product at the end of the design process, however, where centres have suitable CAM facilities, these should be used to enhance the learning process.

It is expected that the evidence for assessment of this unit will come from 4 areas of work:

- An introduction to CAD graphics and the use of CAD tools
- Developing card packaging using CAD and CAM
- Using standard conventions to create detail working drawings

- Designing an item that will be produced using CAM and comparing this to industrial production methods.

Evidence for Assessment Objective 1 will be drawn from the range of work presented in the portfolio but must be assessed separately. In addition to the work presented in other sections it is expected that candidates will produce three CAD drawings that show their ability in using CAD tools to produce:

- repeat patterns
- design of a sign, symbol or logo
- a pictorial elevation.

For higher grades candidates are expected to produce complex CAD drawings eg detailed side elevation of a car, detailed front elevation of a house etc.

It is expected that the evidence for Assessment Objective 2 will come out of a short project based on card packaging. The only assessed part of the work will be the final annotated CAD drawing that would be used as the basis for the CAM process that would eventually produce the package. As well as technical accuracy, consideration should be given to the presentation, layout and detail of the text and images on a single surface of the package. While it is **not required for assessment** it is expected that the 3 dimensional package will be produced.

Evidence for Assessment Objective 3 will be in the form of two orthographic CAD drawings and their associated isometric drawings. The drawings should be produced to the appropriate British Standard convention and contain all the relevant information (in terms of size, material, production processes and surface finish) from which the part or component can be manufactured. The complexity of the item will act as a differentiator and it is not intended that the manufacture is linked to a CAM process.

It is expected that evidence for Assessment Objective 4 to Assessment Objective 7 will come from a project that develops the design for a product or component through to CAM manufacture and on to comparing the process with industrial applications.

A single 3D CAD representation is to be presented for Assessment Objective 4. This should demonstrate the candidate's ability to use a 3 dimensional CAD package to accurately represent an item, from a variety of viewpoints, prior to manufacture. The printed presentation drawing will be fully rendered within the program used and will show more than one view of the object for higher level candidates. The 3D representation may be used to evidence Assessment Objective 5 to Assessment 0bjective 7. The complexity of the item will again act as a grade differentiator.

To show evidence of Assessment Objective 5 a single CAD drawing, using British Standard conventions must be presented. This will contain all the relevant information for the component to be produced using a CAM machine. The complexity of the item and the detail included will again act as a differentiator.

Evidence for assessment of Assessment Objective 6 will be in the form of a report describing the stages of converting the CAD drawing to information for the machine through to the manufacture of the item assessed in Assessment Objective 5.

The evidence for Assessment Objective 7 will be in the form of a short report and will be based on research to identify how CAM is used in industry. Information may come from a variety of sources eg: related to a local manufacturing company who use CAD CAM, a suitable video etc.

Signposting to Key Skills

✓ The unit contains opportunities for developing the Key Skill, and possibly for generating portfolio evidence, if teaching and learning is focused on that aim.

Key Skill reference		Key Skill reference		Key Skill reference	
C2.1a		ICT2.1		N2.1	✓
C2.1b		ICT2.2	✓	N2.2	✓
C2.2		ICT2.3	✓	N2.3	
C2.3	✓				

Mapping to National Occupational Standards

National Occupational Standards	Reference ID	Title
IT Users (e-skills UK)	SBS2	Specialist and bespoke software

Resources

This section provides suggestions of suitable resources. The list is neither prescriptive nor exhaustive, and candidates should be encouraged to gather information from a variety of sources. Some suggested resources are intended for Tutor use. The resources in this section were correct at the time of production.

Books

Designing with Prodesktop – DATA Publications

CAD / CAM a guide for secondary schools – NAAIDT Publication

Discovering CAD with 2D Design – Techsoft Publication
BS EN ISO 128 – 20:2001 (BSI)

Films, videos and broadcasts

Videos:

CAD Creative Design - (DATA)

CAM Revolutionary Designs - (DATA)

CD-Roms and computer software

Software:

Autodesk Inventor

Techsoft 2D Design (or similar)

Pro Desktop (or similar)

CD Roms:

CAD / CAM Cookies - (DATA)

CAD / CAM Resources - (DATA)

Packaging Designer - (NAAIDT)

Our World (MTTA) (TEP)

Grading

Assessment Objective	Pass	Merit	Distinction
AO1 Use CAD tools to produce a range of diagrams and images	Candidates will produce three CAD drawings, showing a limited use of CAD tools. These drawings may not be accurate.	Candidates will produce three CAD drawings, showing use of a wide range of CAD tools. Most of the drawings will be accurate.	Candidates will produce three complex CAD drawings, showing use of a wide range of CAD tools. All drawings will be accurate.
AO2 Use CAD to produce a card package that could be used by a computer controlled card cutting machine	Candidates will produce a simple net with some provision for folding, gluing and fastening, but these may not be accurate. Candidates use relevant text and third party image(s) for one surface.	Candidates will produce an accurate net showing cut and score lines and with good provision for gluing and fastening. Candidates use relevant text and customised images for one surface.	Candidates will produce an accurate net showing cut and score lines and with good provision for gluing and fastening. Candidates use relevant text and produce their own images for one surface.
AO3 Use CAD to produce diagrams that contain all the information needed for the manufacture of components and/or products	Candidates will produce two working drawings. These include the basic information from which simple items can be manufactured.	Candidates will produce two working drawings. These include most of the information from which complex items can be manufactured.	Candidates will produce two accurate working drawings. These include all of the information from which complex items can be manufactured.
AO4 Use CAD as a 3 dimensional modelling tool	Candidates will produce an example of basic shapes simply rendered.	Candidates will produce an example of a more complex object represented, rendered and viewed from 2 positions.	Candidates will produce an example of a complex object represented, skilfully rendered and viewed from a variety of positions.
AO5 Develop the design for a product or component to be manufactured using a CAM machine	Candidates will develop a basic design for a simple shape with brief notes and instructions on how the item is to be manufactured using a CAM machine.	Candidates will develop a clear design for a more complex shape with detailed notes and instructions on how the item is to be manufactured using a CAM machine.	Candidates will develop a clear and accurate design for a complex shape with comprehensive notes and instructions on how the item is to be manufactured using a CAM machine.

Assessment Objective	Pass	Merit	Distinction
AO6 Explain the stages of manufacturing from CAD drawing to finished component using CAM	Candidates will briefly describe the basic stages of setting up and using a CAM machine. The report must include: • how data is transferred to the machine • how the machine is operated • safety features and requirements	Candidates will provide a detailed description of the main stages of setting up and using a CAM machine. The report must include: • how data is transferred to the machine • details of the machine used • how the machine is set up • how the material is fixed into the machine • how the machine is operated • safety features and requirements	Candidates will provide a comprehensive report on all the stages of setting up and using a CAM machine. The report must include: • information on what the part is and what it is to be used for • how data is transferred to the machine • details of the machine used • how the machine is set up • how the material is fixed into the machine • how the machine is operated • safety features and requirements • alternative methods of production
AO7 Explain how components are commercially produced in quantity using CAM machines	Candidates will provide a brief and limited account of how CAM machines are used in industry.	Candidates will provide a detailed and clear account of how CAM machines are used in industry.	Candidates will provide a comprehensive and full account of how CAM machines are used in industry.