Unit 69: Advanced Computer-aided Design Techniques

Unit code: Y/601/1390
QCF level: 4
Credit value: 15

• Aim

The aim of this unit is to enhance learners’ skills in the use of computer-aided design (CAD) and 3D modelling systems to solve a design problem.

• Unit abstract

Product designers communicate their designs through CAD software packages. It is used at all stages of the design task, from conceptualisation to production of working drawings. It provides the basis for manufacturing products. Engineers must master computer-aided design techniques in order to ensure design intent is accurately taken through to manufacture and service. In this unit, the learner will practice the techniques involved in producing advanced 3D models. Simple errors with CAD models and drawings can lead to hugely expensive consequences. This could be in the form of incorrect tooling or products which do not fit or function properly. In industry, competitive advantage is gained through speed to market of new designs. Hence engineers must be able to commit their designs quickly to CAD.

This unit will be beneficial to research and design engineers and production engineers. It will equip the learner with the necessary advanced CAD parametric modelling skills that industry demands. Learners should be able to produce and edit 2D shapes prior to starting this unit. Learners will investigate a CAD software package so as to be able to generate advanced surface and solid models. There are a variety of CAD software packages used in industry today including Pro-Engineer and Solidworks. Whilst there may be differences in using the different softwares, users who are fluent in one software will generally quickly pick up any other.

Entry requirements for this unit are at the discretion of the centre. However, it is advised that learners should have completed appropriate BTEC National units or equivalent. Learners should be able to produce and edit 2D shapes prior to starting this unit. Those who have not attained this standard will require bridging studies.

• Learning outcomes

On successful completion of this unit a learner will:
1. Be able to modify and update an existing design
2. Be able to generate a surface model
3. Be able to generate a solid model.
Unit content

1 Be able to modify and update an existing design

Drawing files: load and create and edit a drawing file from source, including Initial Graphics
Exchange Specification (IGES) and Drawing Exchange Format (DXF) files

Blocks: access externally and internally referenced blocks; update and insert new blocks; use
editing commands to modify existing parts

Record modifications: update the drawing and record modifications; produce updated
documentation using a word-processing package with inserted views relating to
modifications

Produce hard copy: produce hard copy of updated drawing using scaled plots, scaled views,
different printer/plotters and reconfiguring CAD software to suit

2 Be able to generate a surface model

Coordinate systems: manipulate user co-ordinate system (UCS) and world coordinate system
(WCS) to suit required geometry

Correct geometry: using polylines to construct shapes for surfacing and constructing splines;
using polyedit to restructure line/arcs into continuous geometry

Surface construction: generate the bounded geometry required for any surface; use
generated geometry to create surfaces; use of all methods of surface construction with
reference to Bezier, Nurbs, Patch and Coons, to test best construction methods

Facet numbers: numbers required to smooth surface; memory problems using high numbers
of facets

Viewing medium: use of Hide, Shade and Render to visualise the product; print or plot finish
drawing; the use of different textures; lighting controls

3 Be able to generate a solid model

Coordinate systems: manipulate UCS and WCS to suit required geometry

Solid model: using polylines to construct shapes for extruding, using polyedit to restructure
line/arcs into continuous geometry; use of Hide, Shade and Render to visualise the product;
applying various materials to generated slides; cutting the solids and sectioning; different
lighting; textures

Construction techniques: the effects of subtract, union, intersect extrude, sweep and revolve
in model construction; editing the geometry using fillet, chamfer etc; using primitives to
create geometry

Properties of solids: using solid model to find the mass, radius of gyration, centre of gravity
and surface area

Printing image: generating image

Dimension a solid: dimensions are correctly added to a solid composite drawing in multi-
screen mode; dimensions are correctly added to true shapes previously extracted from solid
composite
# Learning outcomes and assessment criteria

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<thead>
<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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<tr>
<td><strong>On successful completion of this unit a learner will:</strong></td>
<td><strong>The learner can:</strong></td>
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</table>
| LO1 Be able to modify and update an existing design | 1.1 load drawing files from varying sources using different formats  
1.2 update the modified blocks and load into drawing  
1.3 modify drawing to new requirements and record modifications  
1.4 create a word-processed report with modified parts of drawing inserted  
1.5 produce and print/plot report and drawing |
| LO2 Be able to generate a surface model | 2.1 manipulate the user coordinate system (UCS) and world coordinate system (WCS) to suit construction requirements  
2.2 produce shapes that contain the correct geometry for the required surface  
2.3 create the correct surface construction  
2.4 produce a surface that is compatible with processing limits  
2.5 create a suitable viewing medium  
2.6 produce a report describing the different methods of constructing a surface |
| LO3 Be able to generate a solid model | 3.1 manipulate the user coordinate system (UCS) and world coordinate system (WCS) to suit construction requirements  
3.2 create bounded geometry for extrusion and revolving  
3.3 produce sections from solid model  
3.4 demonstrate the use of construction techniques  
3.5 produce file containing mass, surface area, radius of gyration and centre of gravity  
3.6 produce a report detailing the uses of solid modelling in the manufacturing process |
Guidance

Links
This unit is designed to stand alone, but it has links with *Unit 8: Engineering Design*, *Unit 14: Computer-aided Machining* and *Unit 15: Design for Manufacture*.

Essential requirements
Centres delivering this unit must be equipped with an industrial-standard CAD package and with printing or plotting facilities for rendered images, for example software Pro-Engineer, Solidworks, AutoCAD, RoboCAD, TurboCAD, and Intergraph.

Employer engagement and vocational contexts
Centres should try to work closely with industrial organisations in order to bring realism and relevance to the unit.

Visits to one or two relevant industrial or commercial organisations that use advanced CAD techniques will be of value to enhance and support learning.