Unit 4027: CAD for Schematics in Maintenance Engineering

Unit Code: Y/651/0898

Level: 4

Credits: 15

Introduction

There is a growing trend, in part due to the popularity of three-dimensional (3D) Computer Aided Design (CAD) systems, for students to generate two-dimensional (2D) drawings from three-dimensional (3D) solid models. 3D models do look impressive and whilst they clearly serve an important function in CAD design, in reality the vast majority of CAD drawings used in the industry are 2D based and, of those, a significant number are schematic drawings utilised by maintenance engineers, which cannot be produced using a 3D system.

The aim of this unit is to enable students to produce 2D CAD drawings (using industry standard CAD software), and to modify and construct electrical and mechanical drawings e.g., distribution systems, fire alarms, steam ranges, electrical and hydraulic circuits. This unit will support the development of the students' CAD abilities and build upon those skills to introduce the more advanced techniques that are used to create and modify schematic drawings quickly and efficiently. These techniques can be used to construct pre-prepared symbols for use in circuit diagrams or be used to create unique symbols and symbol libraries.

Alongside the creation of schematic drawings utilising the block, attributes and insert commands, the students will also learn how to extract information to populate spreadsheets and databases, tabulating the information directly from the working drawing.

Learning Outcomes

By the end of this unit students will be able to:

LO1 Produce CAD drawings

LO2 Create blocks with textual attributes to perform insert and export operations

LO3 Construct complex schematic drawings

LO4 Transfer information to external sources.

Essential content

LO1 **Produce CAD drawings**

Introduction to the user interface:

Command line, Status Bar, panel titles and tabs

Recognise and apply absolute, relative and polar coordinates.

Drafting aids:

Grid, snap, object snap, ortho and polar tracking.

Draw commands:

Line types, circle, text, hatching, dimensioning.

Modifying commands:

Sketch commands, copy, rotate, move, erase, scale, array, chamfer, fillet

Creating and defining text and dimension styles.

Multiline and Single line text

Creating layers:

Layers/levels, colour, line thicknesses

Viewing commands:

Zoom, pan, viewports and layouts.

Case studies:

Industry relevant CAD examples relevant to maintenance engineers.

LO2 **Create blocks with textual attributes to perform insert and export operations**

Blocks and textual attributes:

Creating and editing blocks and write blocks

Defining, editing and managing attributes

Inserting blocks from external sources

Attribute extraction

Dynamic and nested blocks

Using the design centre and tool palettes.

LO3 **Construct complex schematic drawings**

Complex schematics:

Create block library and table legend, including symbols and description

Create electrical, electronic, hydraulic and pneumatic schematic drawings, Process Flow Diagrams (PFDs). Engineering Flow Diagrams (EFDs) and Vent Flow Diagrams (VFDs)

Industry case studies using complex schematic drawings and professional discussion on good practice observed.

LO4 **Transfer information to external sources.**

Electronic transfer of information:

Data extraction and data extraction (DXE) files, DWG/DXF files

Step-files ISO 10303-21

Extracting data to tables and spreadsheets

Organise and refine the extracted data

Table styles and formatting data extraction tables

Present CAD related work undertaken to peers or a team of maintenance engineers and respond to feedback.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Produce CAD drawings</td><td rowspan="2">D1 Evaluate the advantages of using template files.</td></tr>
<tr><td>P1 Propose the range of drawing aids that assist productivity.
P2 For a given engineering maintenance context, produce a template file to include a range of layers, dimension styles, text styles, border and title box.</td><td>M1 Contrast the advantages and disadvantages of using CAD over manual drafting in support of maintenance engineer role.</td></tr>
<tr><td colspan="2">LO2 Create blocks with textual attributes to perform insert and export operations</td><td rowspan="4">LO2 and LO3
D2 Validate how using attributes can improve productivity.</td></tr>
<tr><td>P3 Create ten schematic symbols.
P4 Add appropriate attribute data to each of the schematic symbols and convert into blocks.</td><td>M2 Justify the advantages of using blocks in a drawing.</td></tr>
<tr><td colspan="2">LO3 Construct complex schematic drawings</td></tr>
<tr><td>P5 Construct a block library and table legend and integrate into a template file.
P6 Create a complex schematic drawing using electrical/electronic or hydraulic symbols.</td><td>M3 Describe the advantages of using block libraries and how they can enhance templates.</td></tr>
<tr><td colspan="2">LO4 Transfer information to external sources</td><td rowspan="2">D3 Assess how electronic transfer of information can aid productivity, with example engineering maintenance applications.</td></tr>
<tr><td>P7 Transfer attribute data to Excel spreadsheets.
P8 Explain the advantages of using data extraction (i.e., DXE, DWG, DXF) files.</td><td>M4 Appraise the process for extracting drawing data to create a table.</td></tr>
</table>

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Bi Z. and WANG X. (2020) *Computer Aided Design and Manufacturing*. Wiley.

BS 8888 (2017) *Technical product documentation and specification*.

Metwalli S.M. (2021) *Machine Design with CAD and Optimization*. Wiley.

Omura G. and Benton B.C. (2014) *Mastering AutoCAD 2015 and AutoCAD LT 2015 Essentials*. Autodesk Official Press

Pitroda H. P (2019) *Computer Aided Design: Textbook and Practice book*. Walnut publication

Sarkar J., (2014). *Computer aided design: a conceptual approach*. CRC Press.

Shih R.H. (2024) *Principles and Practice: An Integrated Approach to Engineering Graphics and AutoCAD 2024*. 1st Ed. SDC Publications.

Simmons C.H., Dennis E. and Maguire N.P. (2020) *Manual of Engineering Drawing – British and International Standards.* 5th Ed. Butterworth-Heinemann.

Stark J. (2021) *What Every Engineer Should Know about Practical CAD/CAM Applications.* CRC Press.

Zeus Precision Charts Ltd. *Zeus Precision Data Charts and Reference Tables for Drawing Office, Toolroom & Workshop*.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

CAD Journal – CAD and Applications

Computer-Aided Design

Computer-Aided Design and Applications

Links

This unit links to the following related units:

Unit 4001: Engineering Design

Unit 4023: Computer Aided Design and Manufacture (CAD/CAM)

Unit 4034: Computer Aided Design (CAD) for Engineering.