BTEC

HIGHER NATIONALS

Engineering

Higher National Certificate Lvl 4

Pearson

Unit 23: Computer Aided Design and Manufacture (CAD/CAM)

Unit code	**J/615/1497**
Unit level	**4**
Credit value	**15**

Introduction

The capacity to quickly produce finished components from a software model is now essential in the competitive world of manufacturing. Businesses now invest heavily in Computer Aided Design (CAD) software, Computer Aided Manufacture (CAM) software and Computer Numerical Control (CNC) machines to facilitate this, thus reducing product lead times. CAD gives design engineers the platform to creatively model components that meet the specific needs of the consumer. When these models are combined with CAM software, manufacturing is made a reality.

This unit introduces students to all the stages of the CAD/CAM process and to the process of modelling components using CAD software specifically suitable for transferring to CAM software. Among the topics included in this unit are: programming methods, component set-up, tooling, solid modelling, geometry manipulation, component drawing, importing solid model, manufacturing simulation, data transfer, CNC machine types and inspections.

On successful completion of this unit students will be able to illustrate the key principles of manufacturing using a CAD/CAM system; produce 3D solid models of a component suitable for transfer into a CAM system; use CAM software to generate manufacturing simulations of a component; and design a dimensionally accurate component on a CNC machine using a CAD/CAM system.

Learning Outcomes

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

1. Describe the key principles of manufacturing using a CAD/CAM system.
2. Produce 3D solid models of a component suitable for transfer into a CAM system.
3. Use CAM software to generate manufacturing simulations of a component.
4. Design and produce a dimensionally accurate component on a CNC machine using a CAD/CAM system.

Essential Content

LO1 **Describe the key principles of manufacturing using a CAD/CAM system**

Hardware:

CAD workstation, printers, USB flash drives and network cables

Software:

Operating systems, hard disk requirements, processor, CAD software e.g. SolidWorks, Autodesk Inventor, CATIA; CAM software e.g. Edgecam, Delcam, GibbsCAM, SolidCAM

Inputs:

CAD model, material specifications, tooling data, spindle speeds and feed rate data calculations

Outputs:

CAM files, program code and coordinates, manufacturing sequences, tooling requirements, auxiliary data

Programming methods:

CAD/CAM, manual programming, conversational programming

Component set-up:

Zero datum setting, tool set-up and offsets, axis of movements

Work-holding:

Machine vice, chuck, fixtures, clamping, jigs

Tooling:

Milling cutters, lathe tools, drills, specialist tooling, tool holders, tool turrets and carousels

LO2 **Produce 3D solid models of a component suitable for transfer into a CAM system**

Solid modelling:

Extrude, cut, fillet, chamfer, holes, sweep, revolve, lines, arcs, insert planes, properties of solid models e.g. mass, centre of gravity, surface area

Geometry manipulation:

Mirror, rotate, copy, array, offset

Component drawing:

Set-up template, orthographic and multi-view drawings, sections, scale, dimensions, drawing

Attributes e.g. material, reference points, tolerances, finish

LO3 **Use CAM software to generate manufacturing simulations of a component**

Import solid model:

Set-up, model feature and geometry identification, stock size, material

Manufacturing simulation:

Operations e.g. roughing and finishing, pockets, slots, profiling, holes, tool and work change positions, tool sizes and IDs, speeds and feeds, cutter path simulations, program editing

LO4 **Design and produce a dimensionally accurate component on a CNC machine using a CAD/CAM system**

CNC machine types:

Machining centres, turning centres, MCUs e.g. Fanuc, Siemens, and Heidenhain

Data transfer:

Structured data between CAD and CAM software e.g. datum position and model orientation; file types e.g. SLDPRT, parasolid, STL, IGES, DXF; transfer to CNC machine e.g. network, USB, Ethernet

Inspection:

Manual inspection e.g. using Vernier gauges, bore micrometres

Automated inspection e.g. co-ordinate measuring machine (CMM), stages of inspection throughout manufacturing process

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Describe the key principles of manufacturing using a CAD/CAM system		**D1** Critically evaluate, using illustrative examples, the impact of different machining conditions and specifications on component manufacturing
P1 Describe the hardware and software elements of a typical CAD/CAM system **P2** Describe, with examples, the inputs and outputs of the CAD/CAM process **P3** Explain the different methods of component set-up, work-holding and tooling available on CNC machines	**M1** Analyse the suitability of different programming methods of CNC machines	
LO2 Produce 3D solid models of a component suitable for transfer into a CAM system		**D2** Critically evaluate the effectiveness of using a CAD/CAM system and solid modelling to manufacture components
P4 Design and produce a CAD solid model of a component to be manufactured on a CNC machine **P5** Design a working drawing of a component containing specific manufacturing detail	**M2** Assess the importance of using different geometry manipulation methods for efficient model production	

Pass	Merit	Distinction
LO3 Use CAM software to generate manufacturing simulations of a component		**D3** Analyse the effect of applying different manufacturing techniques and modifications to achieve an optimised production time
P6 Use CAM software to generate a geometrically accurate CAD solid model of a component	**M3** Using CAM software, generate cutter tool path simulations	
LO4 Design and produce a dimensionally accurate component on a CNC machine using a CAD/CAM system		**D4** Critically analyse, giving illustrative examples, the different methods of data transfer through a CAD/CAM system
P7 Detail a part program for a component using CAM software and transfer the part program to a CNC machine and manufacture a component **P8** Describe the structural elements of a CNC Machining Centre **P9** Review a component manufactured on a CNC machine to verify its accuracy	**M4** Analyse different methods of component inspection used in manufacturing	

Recommended Resources

Textbooks

KUNWOO, L. (2000) *Principles of CAD/CAM/CAE*. Pearson.

McMAHAN, C. and BROWNE, J. (1999) *CADCAM: Principles, Practice and Manufacturing Management*. Prentice Hall.

Links

This unit links to the following related units:

Unit 1: Engineering Design