2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 17

Computer Aided Manufacturing (CAM)

L/506/7283

Guided learning hours: 60

VERSION 4 -June 2017 black line indicates updated content

LEVEL 3

UNIT 17: COMPUTER AIDED MANUFACTURING (CAM)

L/506/7283

Guided learning hours: 60

Essential resources required for this unit: CNC programming software, CNC controlled machine, rapid prototyping programming and manufacturing equipment (additive manufacturing)

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Many companies which make products are reliant on computer systems to run the manufacturing processes involved. This is known as Computer Aided Manufacturing (CAM).

The aim of this unit is for learners to understand how CAM systems are used within manufacturing and be able to program and use Computer Numerical Control (CNC) machines to produce components.

They will also learn to produce components using additive manufacturing techniques.

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, athough 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. Understand how computers are used in manufacturing systems	1.1 use of computers in additive and subtractive manufacturing processes 1.2 CNC setting, operating, programming, i.e. • machine structures e.g. o 3, 4, 5 axis o milling o turning o machining centres o welding fabrication machines 1.3 automation in manufacturing i.e. • robotics • systems and control e.g. o electrical o hydraulic o pneumatic o PLC programming 1.4 computer aided planning, i.e. • resource management • production planning • data and database management e.g. o automated ordering systems o production and supplier management 1.5 advantages of using computers in manufacturing (e.g. repeatability, quality, reliability, reduced time, unit cost, responsiveness)

Learning outcomes	Teaching content
The Learner will:	**Learners must be taught:**
2. Be able to produce CNC programs for the manufacture of components	2.1 manual CNC programming, i.e. • part programming, i.e. o CNC coding, i.e. o G codes o co-ordinates i.e. - X, Y, Z coordinates - absolute - incremental o tooling – positions, directions, types and selection o speed and feed rates o tool changing/qualified tooling o how to transfer and load files o how to perform on-screen simulation o adjustment of machine settings through the manipulation of manual programming techniques and program code o dry runs, setting and first off checks o mathematical calculation e.g. - use of cutter speed and feed rate equations - trigonometry and trigonometric ratios 2.2 use of CAM software, i.e. • how to use 3D CAD geometry in a CAD system (e.g. solidworks, inventor, solidedge) • how to export and import data in appropriate formats (e.g. IGES, DXF, STL) • analysis using CAM software (e.g. positioning, machining operations, tooling selection and tool changing, simulate cutting paths, review and improve) 2.3 production and manufacture of parts, i.e. • production planning • download files to machine • set tooling • load program • start cycle and run program
3. Be able to set-up and operate a CNC machine to produce components	3.1 machine set-up i.e. • datums • jigs, fixtures, clamps • setting tooling e.g. o drills o tooling inserts o reamers 3.2 machine operations i.e. • roughing and finishing operations • tool changing • operations list e.g. o irregular geometry o pockets

Learning outcomes	Teaching content
The Learner will:	**Learners must be taught:**
	3.3 machining of components i.e. • cycle time, canned cycle, macros • coolant flow • inspection, i.e. o measurement o check against specification o adjust program based on observations
4. Be able to produce components using additive manufacturing techniques	4.1 rapid prototyping 4.2 3D printing using additive manufacturing techniques, i.e. • Fused Deposition Modelling (FDM) • Selective Laser Sintering (SLS) • Stereolithography (SLA) • Electron Beam Freeform Fabrication (EBF) 4.3 parts for one-off prototyping functions (e.g. fit, form, function, aesthetic, validation) 4.4 how additive manufacturing techniques are used, i.e. • for the production of final components (e.g. aerospace, automotive or motorsport applications) • in advanced applications (e.g. injection mould tool inserts, soluble cores for composite manufacture, advanced geometry creation) 4.5 production of 3D components using additive manufacturing 4.6 production of 3D CAD data and conversion to STL file format

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. Understand how computers are used in manufacturing systems	P1: Explain how computers are used in manufacturing systems.	M1: Analyse the advantages of using computers in manufacturing.	
2. Be able to produce CNC programs for the manufacture of components	P2: Plan the production of a CNC machined component.	M2: Produce a CNC part program using CAD/CAM software.	D1: Analyse the advantages of the use of CAD/CAM software rather than manual programming techniques for a CNC machined component.
	P3: Produce a CNC part program utilising manual programming techniques.		
	P4: Use mathematical calculations to produce accurate part programs for use within a CNC machine. **Synoptic assessment Unit 1 Mathematics for engineering*		

LO	Pass	Merit	Distinction
3. Be able to set-up and operate a CNC machine to produce components	P5: Set-up and operate a CNC machine to produce components.	M3: Prove the accuracy of a machining process by checking a final result against specification.	D2: Evaluate the effectiveness of the Computer Aided Manufacturing (CAM) process used and make recommendations for possible improvements.
4. Be able to produce components using additive manufacturing techniques	P6: Explain different additive manufacturing techniques used in 3D printing.		D3 Assess how additive manufacturing techniques are used for the production of final components and in advanced applications.
	P7: Produce a 3D component using additive manufacturing techniques.	M4: Produce 3D CAD data for the component in STL file format.	

*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: Understand how computers are used in manufacturing systems
Learners should be able to explain and analyse the use of computers in manufacturing systems.

LO2: Be able to produce CNC programs for the manufacture of components
Learners should be able to produce CNC programs for the manufacture of components. They will require access to suitable software, which might include CNC programming and simulation tools. P4 provides an opportunity to for the synoptic application of mathematical knowledge learnt in Unit 1. Teachers might present learners with details of a range of suitable components for which CNC programs can be developed.

LO3: Be able to set-up and operate a CNC machine to produce components
Learners should set-up and operate a CNC machine in order to produce components. Manufactured components might be those for which programs were created in LO2. Access to suitable CNC machinery will be required, although preliminary test production might be undertaken through simulation prior to physical manufacture. Teachers might provide learners with details of suitable components to produce using CNC programs, and through CNC manufacture. Teachers might alternatively be able to access suitable CNC manufacturing equipment external to the centre (e.g. with an employer, local college or university).

LO4: Be able to produce components using additive manufacturing techniques
Learners should produce components using additive manufacturing techniques (rapid prototyping). Access to suitable additive manufacturing equipment will be required, and also to suitable programming software. Teachers might also be able to access suitable additive manufacturing equipment external to the centre (e.g. with an employer, local college or university).

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 Manufacturing 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.	• Learners undertake work placements in engineering or manufacturing businesses where Computer Aided Manufacturing (CAM) tools, machines and techniques are used. Learners should get the opportunity to gain practical exposure to how CAM systems are utilised in line with industrial practice. • Employers host in-centre or industrially placed master classes showcasing use of tools, techniques and practices, supported with examples of components or products produced using Computer Aided Manufacturing (CAM) techniques.
2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	• Employers give centres engineering drawings of components that learners have to produce using Computer Aided Manufacturing (CAM) techniques. • Employers provide programs for learners to use that allow learners to focus on the setup and operation of the machinery and produce industrial specification, employer supplied components. • Industrial practitioners launch learning activities that are current live projects.

Meaningful employer engagement	Suggestion/ideas for centres when delivering this unit
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.	• Ensure employer input through master classes where employers showcase best practice methodologies in the use of CAM tools, software and machinery. • Employers deliver lectures, talks or seminars that explain how they utilise CAM within their business. • Employers deliver sessions that showcase the link across skills and units. This may include the link between Computer Aided Manufacturing (CAM) units and Computer Aided Design (CAD) or the application of mathematical tools such as trigonometry to produce programs or set up manufacturing operations.
4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a learner'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.	• Employers set industrial level tasks that learners have to develop. This may be an engineering drawing of a component that the learners have to machine using CAM tools or a 3D model of a file that forms the basis of a CAD/CAM component production exercise.

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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