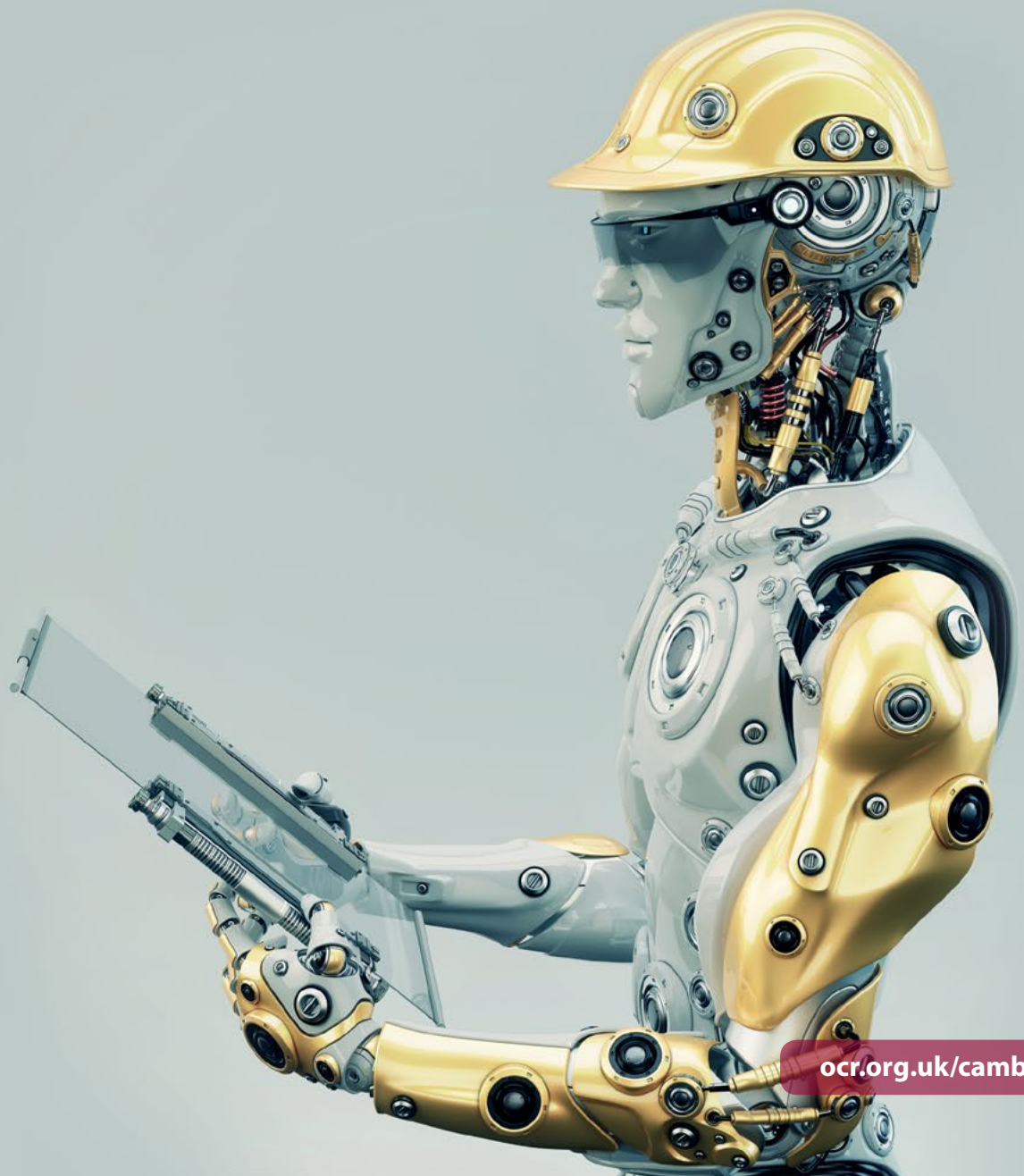
OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 2 & 3**

Cambridge TECHNICALS 2016

ENGINEERING

Summary Brochure
2017/2018
Version 3



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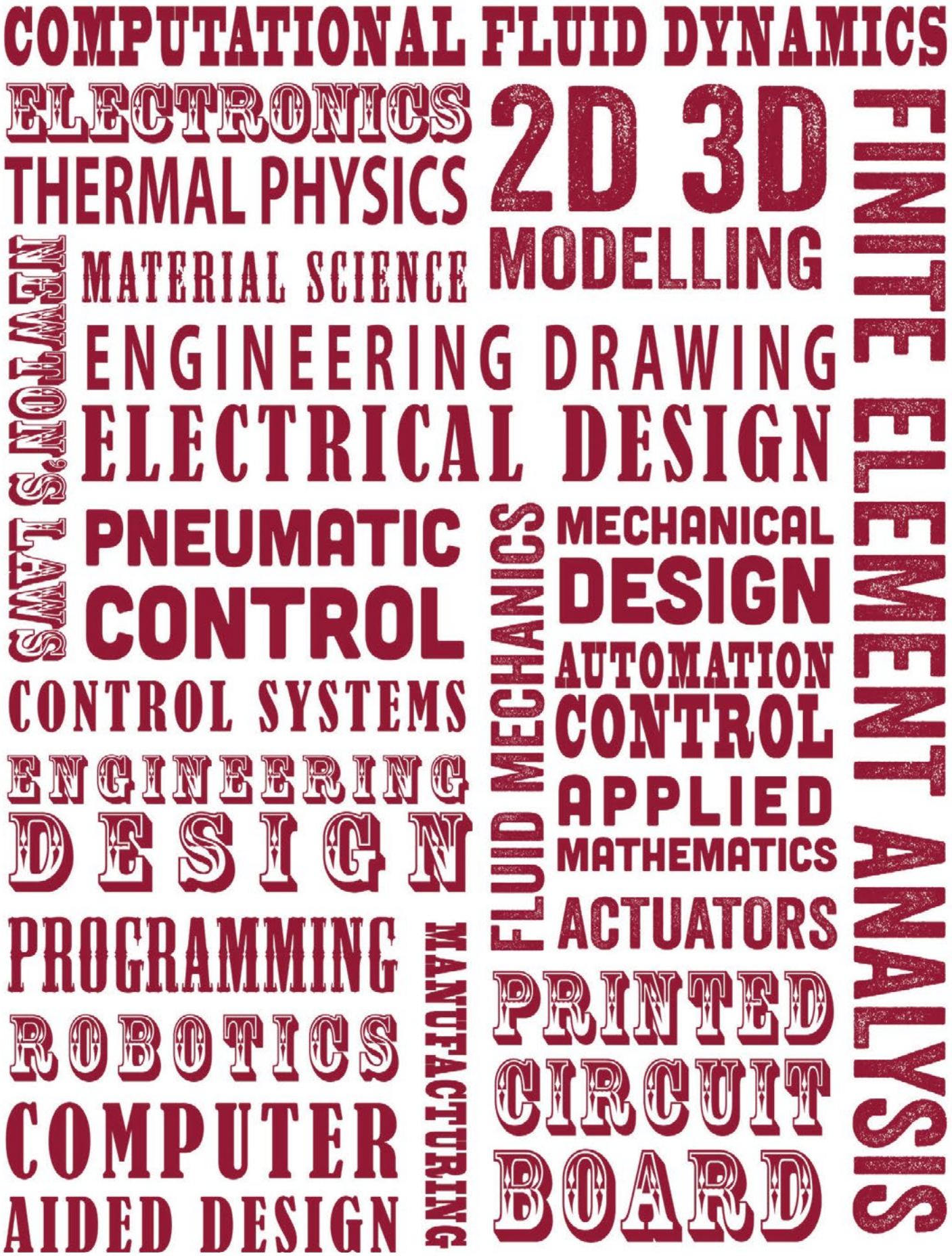

COMPUTATIONAL FLUID DYNAMICS
ELECTRONICS
2D 3D
FINITE ELEMENT ANALYSIS
THERMAL PHYSICS
MODELLING
NEWTON'S LAWS
MATERIAL SCIENCE
ENGINEERING DRAWING
ELECTRICAL DESIGN
PNEUMATIC
FLUID MECHANICS
MECHANICAL
DESIGN
CONTROL
AUTOMATION
CONTROL SYSTEMS
CONTROL
ENGINEERING
APPLIED
DESIGN
MATHEMATICS
PROGRAMMING
ACTUATORS
MANUFACTURING
PRINTED
ROBOTICS
CIRCUIT
COMPUTER
BOARD
AIDED DESIGN

OCR is a not-for-profit organisation. For us, success is measured through the impact and reach of our activities and the scale of our contribution in helping students realise their aspirations.

Our purpose is to work in partnership with others to provide general and vocational qualifications that support education in ways that enable students to reach their full potential, equip them with the knowledge and skills they need for their future, and to recognise and celebrate their achievements.

We develop our qualifications in close consultation with teachers, industry leaders and government to ensure they are relevant for today's students and meet requirements set by the Office of Qualifications and Examinations Regulation (Ofqual).

Level 2 Cambridge Technicals Suite

- New suite for first teaching September 2017
- Externally assessed content
- Eligible for Key Stage 5 performance points from 2019
- Designed to meet the DfE technical guidance

Level 3 Cambridge Technicals Suite

- New suite for first teaching September 2016
- Externally assessed content
- Eligible for Key Stage 5 performance points from 2018 performance tables and 2019 performance tables
- Designed to meet the DfE technical guidance
- Attracts UCAS points at Level 3

Our Cambridge Technicals suite gives you the reassurance that you have the right qualifications to support your students' lifelong learning journey.

Cambridge Technicals are vocational qualifications at Level 2 and Level 3 for students aged 16+. They're designed with the workplace in mind and provide a high-quality alternative to A Levels, with a great range of subjects to choose from.

Vocational education is not just about results, it's about educating people in the knowledge and skills required for employment and for the community as a whole. It's also about developing the behaviours and attributes needed to progress and succeed in education and in work.

Our offer:

Subject	Level 2	Level 3
Art and Design	✓ (2012 suite only)	✓ (2012 suite only)
Business	✓	✓
Media/Digital Media	✓	✓
Engineering	✓	✓
Health and Social Care	✓	✓
IT	✓	✓
Science/Laboratory Skills	✓	✓
Performing Arts	✓	✓
Sport and Physical Activity	✓	✓

The qualifications allow for a high degree of flexibility with the choice of units that make up the qualifications, so your students can specialise in the specific areas of the subject that interest them most.

LEVEL 2 CAMBRIDGE TECHNICALS IN ENGINEERING

Launched for first teaching September 2017, our Level 2 Cambridge Technicals in Engineering qualifications will allow your students to achieve their potential and progress to the next stage of their lives. Whether it be Higher Education, an apprenticeship or employment.

We've designed exciting content, that's engaging, fit for purpose and suitable for the needs of your students.

Launched for first teaching September 2017, our Level 2 Cambridge Technicals in Engineering qualifications will allow your students to take units that are specific to areas within the Engineering industry. These qualifications are designed to take your students straight into employment, or an apprenticeship, or onto further study via a Level 3 Tech Level.

Your students would take these qualifications to develop a set of skills and knowledge required by the Engineering industry. The Certificate is likely to be taken alongside other programmes such as vocational qualifications or A levels over a one-year course of study. When taken as part of a balanced curriculum, there is a clear progression route to an apprenticeship or entry level employment.

Your students would take the Diploma if they want to learn about a specific sector such as Design Engineering, Production Engineering or Systems Engineering. The Diploma is likely to be taken alongside other programmes such as vocational qualifications or A levels over a one-year course of study. The Diploma would form the substantive part of a one-year study programme.

The Qualifications

All qualifications across the Cambridge Technicals in Engineering suite have the ability to be co-teachable; allowing for flexibility within the delivery of study programme.

Level 2 Cambridge Technicals in Engineering

Scheme code	Qualification title	Guided learning hours (GLH)
05887	Level 2 Cambridge Technical Certificate in Engineering	180
05888	Level 2 Cambridge Technical Diploma in Engineering	360

Level 2 Pathways

Students studying the Diploma qualification will have the choice of three different pathways:

- Design Engineering Pathway
- Production Engineering Pathway
- Systems Engineering Pathway

At least one pathway must be achieved.

Design Engineering Pathway

This pathway will equip your students with the the skills, knowledge and understanding to produce engineering drawings of different components, assemblies and circuits using a variety of drawing and computer-aided design techniques.

Production Engineering Pathway

This pathway will equip your students with the knowledge and understanding of how a product manufacturing process is devised and implemented.

Systems Engineering Pathway

This pathway will equip your students with the knowledge and understanding of maintaining engineering systems and products, to optimise their performance.

Progression

If your students leave your institution or change their mind on their final destination, they have the opportunity to move up/move down different qualification sizes.

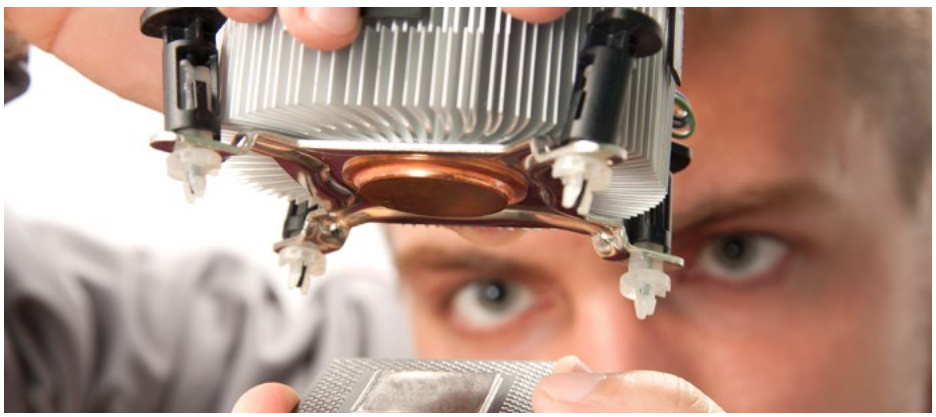
Cambridge Technicals provide a strong base for progression to further study apprenticeships or employment.

DfE Key Stage 5 Level 2

We've made the decision to position the 180GLH and 360GLH Level 2 Cambridge Technicals in the 'Technical Certificate' category as outlined in the DfE's technical guidance. Technical Certificates have characteristics defined by the DfE in order for the qualification to be recognised in the new Key Stage 5 accountability measures.

Technical Certificates

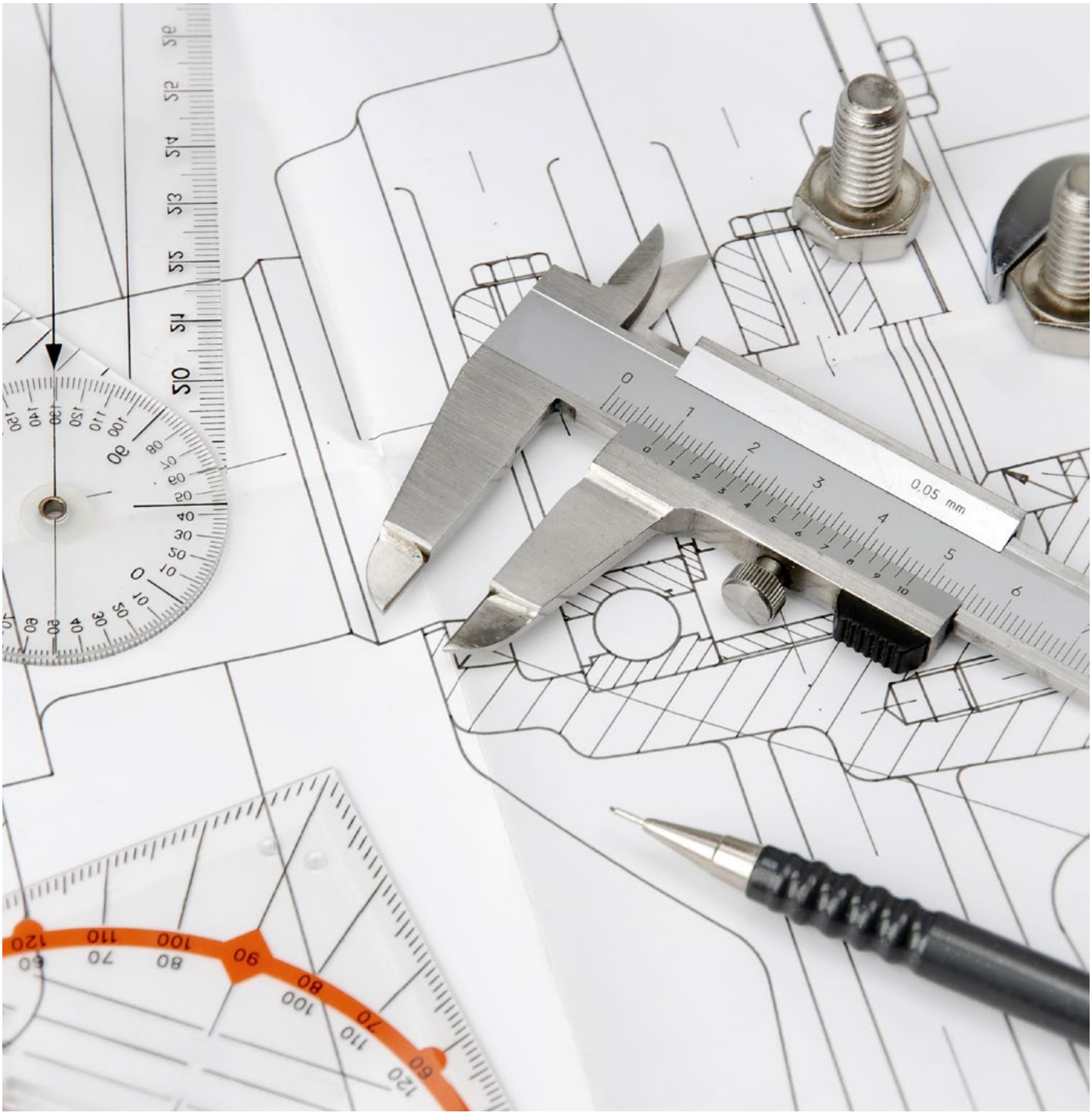
Cambridge Technicals designed to meet the DfE's Technical Certificate characteristics will provide your students with the skills required when starting out in their chosen career. We've worked with key industry employers and experts to make sure the Cambridge Technicals provide your students with the right knowledge and competence required when entering into employment. These qualifications will include a range of mandatory, optional and specialist pathway units; allowing your students to really focus on what is right for their chosen career. path.



Collaborators

The Cambridge Technicals in Engineering have had support from a range of employers. These include:

Employers
Festo
JCB
Jaguar Land Rover
Siemens
Society of Operations Engineers



M = Mandatory PM = Pathway Mandatory				Certificate in Engineering - 180GLH	Diploma in Engineering - 360GLH		
				Engineering Operative	Engineering Technician		
Number of units needed				3	6		
					PATHWAYS		
Unit number	Unit title	Assessment method	Guided Learning Hours		Design Engineering	Production Engineering	Systems Engineering
1	Fundamentals of Mechanical, Electrical/Electronic and Fluid Power Engineering	E	60	M	M	M	M
2	Application of Engineering Principles	E	30	M	M	M	M
3	Mechanical Engineering - Machine Operations	I	90	M	M	M	M
4	Electrical, Electronic Engineering - Operations and Application	I	60	–	M	M	M
5	Engineering Systems Control - Operations and Application	I	60	–	M	M	M
6	Develop and Present Engineering 2D and 3D Design Solutions	I	60	–	PM	–	–
7	Product Manufacture and Fabrication	I	60	–	–	PM	–
8	Optimise and Maintain Performance in Engineering Systems	I	60	–	–	–	PM

UNITS – AIM AND PURPOSE

Unit 1

Fundamentals of Mechanical, Electrical/Electronic and Fluid Power Engineering

Every engineer needs to have a working knowledge of mechanical, electrical/electronic and fluid power engineering and this unit will give your students the fundamental knowledge of each.

From this unit they will know:

- how to use SI units of measurement and their derivatives
- how to classify engineering materials
- the physical properties of engineering materials and how they behave in relation to mechanics, motion and forces
- the electrical and electronic principles for electronic control and electrical motion
- fluid power components and their symbols and how to calculate fluid power.

Students will need to secure the knowledge in this unit so that they can complete the other units in the qualification. For example, they will need to use their knowledge of SI units to interpret engineering drawings in order to make components from an engineering drawing. They will also need to calculate force and motion accurately so that they can repair engineered assemblies.

Unit 2

Application of Engineering Principles

Engineering relies on the practical application of fundamental principles in order to develop working products and systems that will fulfil their desired purpose. As an engineer you will be focused on efficiency, accuracy and tolerances and how you balance these will affect how successful the engineering output will be. Through this unit your students will develop their understanding of a range of engineering applications and be tested on their ability to choose the right device/component for the job, choose the best material to gain efficiency and accuracy in engineering systems to perform typical engineering tasks and solve problems. The typical engineering tasks and problem solving will be based around mechanical, electrical/electronic and fluid power and students will also be required you to use their knowledge from Unit 1.

The knowledge, understanding and skills that your students will gain from this unit will help to prepare them for future employment within the engineering sector.

From this unit they will understand:

- efficiency of mechanical systems
- applications and processing of engineering materials
- non-destructive materials testing techniques
- methods of joining and assembly
- the application of electrical and electronic systems and devices
- fluid power applications.

Unit 3

Mechanical Engineering - Machine Operations

The aim of this unit is for your students to gain awareness of appropriate Health and Safety legislation and procedures. They will then consider how materials and equipment should be handled safely and the most appropriate personal protective equipment (PPE) to use when undertaking particular engineering activities.

The unit will also focus on the application of engineering processes used to create and form shapes through different machining techniques. Students will learn how to select, set-up, monitor and use machining techniques that involve shaping or forming with loss of volume. They will also use work-holding devices and a range of tools so that they can carry out a variety of engineering machining processes. They will learn how to inspect the items they produce for compliance, tolerance and accuracy.

Unit 4

Electrical, Electronic Engineering - Operations and Application

The aim of this unit is for your students to develop the knowledge, understanding and skills to be able to perform electrical operations safely.

They will develop knowledge and practical skills of:

- being able to work safely with electrical systems
- interpret circuit diagrams
- construct electronic circuits
- fault find electronic circuits.

Unit 5

Engineering Systems Control - Operations and Application

Automation control systems exist in every area of engineering and can also be found in numerous other domestic and commercial applications. These automation control systems are fundamental to the effective operation of most aspects of the build environment and require engineers to programme, operate or maintain them.

The aim of this unit is for your students to implement an automated control system including the electrical/electronic and mechanical aspects of the system.

They will develop both knowledge and skills of:

- the key components, applications and basic architecture of programmable devices
- construction of an automated control system using sensors/transducers, actuators and mechanical devices
- programming an identified automated control system
- testing the operation of an automated control system.

Unit 6

Develop and Present Engineering 2D and 3D Design Solutions

This unit will enable your students to develop the skills, knowledge and understanding to produce engineering drawings of different components, assemblies and circuits using a variety of drawing and computer-aided design techniques.

This unit enables them to develop the knowledge and skills needed to set-up and operate a 3D parametric computer-aided drawing (CAD) modelling system to produce fully detailed 3D models and 2D drawings for engineering activities.

The drawings produced will include detailed component drawings for manufacturing and assembly drawings.

Unit 7

Product Manufacture and Fabrication

Once engineers have designed a product, the production engineer devises exactly how it is going to be made, what processes and machines are going to be used and how it can be made as efficiently and as safely as possible. Some products are only made as one-offs whilst others are made in their millions. This unit will explore engineering production systems.

Your students will develop knowledge and understanding of how a product manufacturing process is devised and implemented and undertake practical activities to develop their understanding of:

- Health and Safety practice
- assembly techniques
- lean manufacture
- quality systems
- planning manufacturing production
- scale of production
- how production machines work.

Unit 8

Optimise and Maintain Performance in Engineering Systems

The aim of this unit is to provide your students with knowledge and understanding of maintaining engineering systems and products, to optimise their performance.

In this unit students will learn about the business benefits of routine servicing and maintenance, and the consequences of not properly inspecting and maintaining engineered systems and products.

They will be able to work safely to perform scheduled servicing and adjustments to manufacturer's specifications using tools and diagnostic resources. They will follow testing and diagnostic procedures to identify wear and faults to inform corrective actions.

They will also understand how maintenance contributes to sustainability of products, resources and the impact on the environment.

LEVEL 3 CAMBRIDGE TECHNICALS IN ENGINEERING

Launched for first teaching from September 2015, our Level 3 Cambridge Technicals in Engineering qualifications will allow your students to achieve their potential and progress to the next stage of their lives. Whether it be Higher Education, an apprenticeship or employment.

We've designed exciting content, that's engaging, fit for purpose and suitable for the needs of your students.

Launched from September 2015, our Level 3 suite has five sizes of qualification, giving your students the ability to choose the qualification that's right for their chosen destination. Our larger sized qualifications provide your students with specialist pathways allowing them to specialise in an area of interest or prepare for their chosen career.

Mandatory content and external assessment to meet the DfE's technical guidance, centre assessed including practical and wider project-based assessment opportunities, plus OCR visiting moderation providing centre feedback and support; has resulted in focused qualifications which, dependent on the size chosen, either complement a Key Stage 5 study programme alongside other vocational qualifications, GCSEs, A Levels, or may constitute the bulk of a two-year study programme.

For Engineering, there was recognition that a scientific and mathematical core was needed for all sizes of qualification, and that both employers and particularly higher education institutions (HEIs) needed to clearly see evidence of this taught content. At the same time, it was felt important within an applied/technical qualification that the maths and science content was clearly focussed on Engineering, and that similar GCE content which was not as relevant to this area was removed.

With a wide range of centre assessed units with practical and wider projectbased assessment opportunities, as well as examined units on the Principles of Mechanical Engineering and Principles of Electrical and Electronic Engineering, this has resulted in focussed qualifications which, dependent on the size chosen, either complement a Key Stage 5 study programme alongside A Levels, or may constitute the bulk of a two-year study programme.

The Qualifications

All qualifications across the Cambridge Technicals in Engineering suite have the ability to be co-teachable; allowing for flexibility within the delivery of study programme.

Level 3 Cambridge Technicals in Engineering

Scheme code	Qualification title	Guided learning hours (GLH)
05822	Level 3 Cambridge Technical Certificate in Engineering Principles	180
05823	Level 3 Cambridge Technical Extended Certificate in Engineering	360
05824	Level 3 Cambridge Technical Foundation Diploma in Engineering (VRQ)	540
05825	Level 3 Cambridge Technical Diploma in Engineering (VRQ)	720
05873	Level 3 Cambridge Technical Extended Diploma in Engineering (VRQ)	1080

Diploma Pathways

The Foundation Diploma and Diploma have four vocational pathways within them that can be followed, and students can achieve up to two of these within a Diploma.

The Extended Diploma has two vocational pathways which can be followed, students can only achieve one of these within the Extended Diploma.

Mechanical

This mechanical engineering and design pathway has plenty of opportunities to solve problems that help improve people's lives. It prepares your students for an engineering career in any number of engineering sectors. The successful manufacture of any product depends on well planned, accurate and complete design solutions. Students will develop an appreciation of engineering drawings, freehand graphical techniques, formal drawing techniques, as well as Computer Aided Design (CAD) and simulation tools within commercial CAD systems. Advanced Technology, materials and materials science as well as simulation modelling are also studied in this pathway.

Electrical

The electrical and electronic engineering pathway offers an opportunity to understand the intricate world of electrics and electronics and has been developed to prepare your students for a career in engineering with a bias in electrical systems control. Skills necessary in engineering businesses such as aerospace and transportation will certainly include electronics in addition to mechanics. This pathway considers areas in electrical and electronic design, circuit simulation and manufacture as well as a detailed understanding of electronic devices that contribute to a modern energy-efficient world.

Automation systems and control

Automation systems and control pathway focuses on developing skills in automated electrical, mechanical, hydraulic and pneumatic machines that are operated by systems of control. Students will explore programming techniques and program Programmable Logic Controllers (PLCs) as well as other embedded devices for a control system. Industrial automation control systems are dependent on engineers who know how to programme them in businesses such as manufacturing, power generation, automotive, aerospace and many more. These engineers need to understand control systems and the programming methods and techniques in the specific context to these industrial control systems.

Manufacturing

The manufacturing pathway focuses on the challenges of modern global manufacturing industries and the development of skilled techniques of manufacturing and its related technologies. Your students will study industrial manufacturing engineering principles and appreciate how aspects such as Computer Numeric Manufacture (CAM) and lean manufacture are integrated so that the productivity is improved, the costs of manufacture are reduced and products and services are delivered when required. Students will also study how business can meet the demands of its customers by the methods they use to inspect and test their goods and products prior to completion, to guarantee their levels of quality.

Progression

If your students leave your institution or change their mind on their final destination, they have the opportunity to top up/move down different qualification sizes. Cambridge Technicals provide a strong base for progression to either university, apprenticeships or work and are recognised for UCAS tariff points*

*It is important to check individual course requirements when applying to university.

DfE Key Stage 5 Performance Measures

We've made a decision to position the Cambridge Technicals across the 'Applied General' and 'Tech Level' categories outlined in the DfE's technical guidance for Key Stage 5. Each category has characteristics defined by the DfE in order for the qualification to be recognised in the new Key Stage 5 accountability measures. We believe that providing your students with qualifications that are right for their chosen destination will better equip them for the future.

Applied General

You can be confident that we are working with universities to make sure that Cambridge Technicals designed to meet the Applied General characteristics will provide your students with the depth and breadth of knowledge, understanding and skills required for further study in that subject area at Higher Education. These qualifications will include a range of mandatory and optional units.

We're conscious that due to changes in A Level curriculum and assessment, some students who would generally undertake an academic qualification may benefit from taking an Applied General vocational qualification that is designed for progression to Higher Education.

The Cambridge Technicals in Engineering will include AS and A2 equivalent size qualifications, which will have nested units enabling your students to move from one size to the other. We're aware that the decoupling of the AS from the A Level may not provide the flexibility you need in order to offer a comprehensive study programme. Therefore, the Cambridge Technicals will provide you with the solution you need in order to give students optionality within their study programme, at the same time as making sure they have a recognised qualification designed to take them to university.

Tech Level

Cambridge Technicals designed to meet the DfE's Tech Level characteristics will provide your students with the skills required when starting out in their chosen career. We've worked with key industry employers and experts to make sure the Cambridge Technicals provide your students with the right knowledge and competence required when entering into employment. These qualifications will include a range of mandatory, optional and specialist pathway units; allowing your students to really focus on what is right for their chosen career path.

Collaborators

The Cambridge Technicals in Engineering have had support from a range of employers and universities. These include:

Employers	HEIs
Jaguar Land Rover	Coventry University
Siemens	Northampton University
National Grid	Manchester Metropolitan University
Tata Steel	
Royal Academy of Engineering	
Society of Operations Engineers	
Cummins Engineering	
CargoStrap	
Festo	
JCB	

M = Mandatory
O = Optional
PO = Pathway Optional

				Applied General		Tech Level									
				Certificate in Engineering (180 GLH)	Extended Certificate in Engineering (360 GLH)	Foundation Diploma in Engineering (540 GLH)				Diploma in Engineering (720 GLH)				Extended Diploma in Engineering (1080 GLH)*	
Number of units needed				3	6	9				12				18	
Unit number	Unit title	Assessment method	Guided Learning Hours			Electrical and Electronic Engineering	Mechanical Engineering and Design	Automation, Systems and Control	Manufacturing	Electrical and Electronic Engineering	Mechanical Engineering and Design	Automation, Systems and Control	Manufacturing	Mechanical, Electrical and Electronic Systems Design and Engineering	Engineering Automation Control and Manufacturing Processes
01	Mathematics for Engineering	E	60	M	M	M	M	M	M	M	M	M	M	M	M
02	Science for Engineering	E	60	M	M	M	M	M	M	M	M	M	M	M	M
03	Principles of Mechanical Engineering	E	60	O	M	O	M	PO	PO	M	M	M	M	M	M
04	Principles of Electrical and Electronic Engineering	E	60	O	M	M	O	PO	PO	M	M	M	M	M	M
05	Electrical and Electronic Design	I	60	–	O	M	O	O	O	M	O	O	O	M	O
06	Circuit Simulation and Manufacture	I	60	–	–	M	O	O	O	M	O	O	O	M	–
07	Electrical Devices	I	60	–	–	PO	O	O	O	PO	O	O	O	M	–
08	Electrical Operations	I	60	–	–	PO	O	O	O	PO	O	O	O	M	–
09	Mechanical Design	I	60	–	O	O	M	O	O	O	M	O	O	M	O
10	Computer Aided Design (CAD)	I	60	–	O	O	M	O	O	O	M	O	O	M	M
11	Materials Science	I	60	–	O	O	PO	O	O	O	PO	O	O	M	M
12	Mechanical Simulation and Modelling	I	60	–	–	O	PO	O	O	O	PO	O	O	M	–
13	Mechanical Operations	I	60	–	–	O	PO	O	O	O	PO	O	O	M	M
14	Automation Control and Robotics	I	60	–	–	O	O	M	O	O	O	M	O	O	M
15	Electrical, Mechanical, Hydraulic and Pneumatic Control	I	60	–	–	O	O	M	O	O	O	M	O	O	M
16	Systems and Programming	I	60	–	–	O	O	M	O	O	O	M	O	–	M
17	Computer Aided Manufacture (CAM)	I	60	–	O	O	O	O	M	O	O	O	M	–	M
18	Lean and Quality	I	60	–	–	O	O	O	M	O	O	O	M	–	M
19	Inspection and Testing	I	60	–	–	O	O	O	M	O	O	O	M	–	M
20	Business for Engineering	I	60	–	O	O	O	O	O	O	O	O	O	O	O
21	Maintenance	I	60	–	–	O	O	O	O	O	O	O	O	O	O
22	Engineering and the Environment	I	60	–	O	O	O	O	O	O	O	O	O	O	O
23	Applied Mathematics for Engineering	E	60	–	O	O	O	O	O	O	O	O	O	O	O
24	Project management for Engineers	E	90	–	–	–	–	–	–	–	–	–	–	M	M
25	Promoting Continuous Improvement	I	30	–	–	–	–	–	–	–	–	–	–	M	M

UNITS – AIM AND PURPOSE

Unit 1
Mathematics for Engineering

Mathematics is one of the fundamental tools of the engineer. It underpins every branch of engineering and the calculations involved are needed to apply almost every engineering skill.

This unit will develop your students knowledge and understanding of the mathematical techniques commonly used to solve a range of engineering problems.

By completing this unit they will develop an understanding of:

- algebra relevant to engineering problems
- the use of geometry and graphs in the context of engineering problems
- exponentials and logarithms related to engineering problems
- the use of trigonometry in the context of engineering problems
- calculus relevant to engineering problems
- how statistics and probability are applied in the context of engineering problems.

Unit 2
Science for Engineering

Different branches of science underpin the teaching and learning of a number of engineering disciplines. In this unit we focus on the science which supports mechanical engineering, electrical and electronic engineering, fluid dynamics, thermal physics and material science for engineering.

This unit will develop your students knowledge and understanding of principles of engineering science and consider how these can be applied to a range of engineering situations.

By completing this unit they will:

- understand applications of SI units and measurement
- understand fundamental scientific principles of mechanical engineering
- understand fundamental scientific principles of electrical and electronic engineering
- understand properties of materials
- know the basic principles of fluid mechanics
- know the basic principles of thermal physics.

Unit 3
Principles of Mechanical Engineering

All machines and structures are constructed using the principles of mechanical engineering. Machines are made up of components and mechanisms working in combination. Engineers need to understand the principles that govern the behaviour of these components and mechanisms. This unit explores these principles and how they are applied.

By completing this unit your students will develop an understanding of:

- systems of forces and types of loading on mechanical components
- the fundamental geometric properties relevant to mechanical engineering
- levers, pulleys and gearing
- the properties of beams
- the principles of dynamic systems.

Unit 4
Principles of Electrical and Electronic Engineering

Electrical systems and electronic devices are present in almost every aspect of modern life – and it is electrical and electronic engineers who design, test and produce these systems and devices.

This unit will develop your students knowledge and understanding of the fundamental principles that underpin electrical and electronic engineering.

By completing this unit they will develop an understanding of:

- fundamental electrical principles
- alternating voltage and current
- electric motors and generators
- power supplies and power system protection
- analogue electronics
- digital electronics.

Unit 5
Electrical and Electronic Design

All electrical and electronic devices rely on their components working effectively. This in turn relies on effective manufacture, and ultimately on the successful design of electrical components.

The aim of this unit is for your students to develop the ability to be able to apply knowledge of AC and DC circuit theory to circuit design, and to apply a systems approach to electrical design, developing knowledge of the component devices needed to be able to do this.

Students will develop an understanding of the applications of electromagnetism in electrical design, and the ability to be able to use both semi-conductors and programmable process devices in their designs.

Unit 6

Circuit Simulation and Manufacture

For electrical and electronic devices to function, they depend on their circuits operating normally. Circuit simulation and safe, effective manufacture of circuit boards is therefore a key function within electrical engineering companies.

The aim of this unit is for your students to develop the ability to make working Printed Circuit Boards (PCBs).

They will develop the ability to use Computer Aided Design (CAD) software to design and simulate electronic circuits, and then to design PCBs. They will go on to be able to safely manufacture and construct PCBs.

They will also develop your fault-finding techniques for PCBs, to test and rectify, where possible, faults on circuits. They'll also gain knowledge on the commercial manufacture of circuits, including manufacturing process methods and quality assurance techniques.

Unit 7

Electrical Devices

Electrical devices in engineering companies are used for many purposes, from sensors and actuators used in robotic manufacture to Programmable Logic Controllers (PLCs) which can control automated assembly lines.

The aim of this unit is for your students to develop knowledge and understanding of electrical devices including semi-conductor and programmable devices and sensors and actuators. They will also develop an understanding of their applications within electrical and electronic engineering companies.

Students will also develop an understanding of signal conditioning techniques and signal conversion devices, and on the use of smart and modern materials in electrical devices.

Unit 8

Electrical Operations

Manufacturing of electrical components and devices is a skilled role upon which many industries depend for their own products.

The aim of this unit is for your students to develop the knowledge, understanding and skills to be able to produce electrical components safely.

They will develop underpinning knowledge about the performance characteristics of electrical and electronic components and devices. They will go on to learn how to work safely with electricity, develop the ability to construct a circuit, and to test and fault find electrical and electronic equipment as part of the quality assurance process.

Unit 9

Mechanical Design

The successful manufacture of mechanical components and products depends on well planned, accurate and complete design solutions.

The aim of this unit is for your students to develop the knowledge, understanding and skills to be successful in their design of mechanical engineering components and products.

Students will develop knowledge and understanding of engineering drawings, both freehand graphical techniques, and more formal drawing techniques. They will also be able to select the appropriate engineering materials to achieve their design solutions.

They will be able to produce a design which can successfully be manufactured, and finally learn how to optimise a design to improve performance.

Unit 10

Computer Aided Design (CAD)

Computer Aided Design (CAD) has been used across the world for many years in many diverse industries to design products, including both mechanical and electrical component and product design. A variety of software packages are used to perform this commercially.

The aim of this unit is for your students to develop the ability to be able to create 3D models using CAD, and to go on to create 3D assemblies of components within a CAD system.

To underpin this, they will develop the skill of producing 2D CAD engineering drawings to appropriate standards, and will develop knowledge and understanding of the use of simulation tools within commercial CAD systems.

Unit 11

Materials Science

Awareness of materials science is needed by design engineers and all other types of engineers in order that they can make informed decisions about the engineering materials they choose to use in design and manufacture.

The aim of this unit is for your students to understand material structure and classification, and common properties, standard forms and failure modes of engineering materials.

They will develop an understanding of industrial material processing techniques, and how this is affected by materials' properties.

They'll gain knowledge on the application and uses of modern and smart materials, and develop the ability to be able to test the suitability of different engineering materials for their intended application.

Unit 12

Mechanical Simulation and Modelling

Engineering companies, once they have designed components, must carry out CAD simulation and modelling to test that design and fitness for purpose.

The aim of this unit is for your students to develop the skills required to carry out simulations of components, products, assemblies or systems within Computer Aided Design (CAD) software packages – this will include simulations of reactions within mechanical assemblies, and simulations to assess the manufacturability of components.

To assess subsequent operational performance, students will develop the knowledge and skills to be able to carry out Finite Element Analysis (FEA) and Computational Fluid Dynamic (CFD) simulations utilising Computer Aided Design (CAD) software packages, in order to assess the performance of components, products or systems.

They will use this information to identify potential issues and subsequent improvements to designs.

This unit builds directly on skills gained in Unit 10 Computer Aided Design (CAD). It is strongly recommended that this unit should be studied first.

Unit 13

Mechanical Operations

Production and manufacturing businesses depend on a team that can actually plan production, carry out production with the appropriate equipment, and quality assure what they have physically produced.

The aim of this unit is for your students to develop the ability to plan for production, and to manufacture components safely. They will develop their knowledge of manufacturing techniques to include marking out, use of hand tools and the operation of manually controlled machines such as lathes and milling and drilling machines. Students will produce mechanical components and will be able to quality assure their own work as being fit for purpose.

Unit 14

Automation Control and Robotics

Many companies use automation control devices to run manufacturing, production and other processes such as power generation. These machines require specialist engineers to design, manufacture, operate and maintain them. Industrial robots are also becoming increasingly commonly used, in automation control systems.

The aim of this unit is for your students to develop knowledge and understanding of automation control systems in industry. They will develop understanding of control system theory and how this is implemented in automation control systems.

They will develop understanding of how sensors and actuators are used in automation control systems, about industrial network systems including industrial communication standards (e.g. canbus), and the role of maintenance for automation control systems.

They'll also develop an understanding of the application of robotics in automation control systems, including aspects of robotic operation.

Unit 15

Electrical, Mechanical, Hydraulic and Pneumatic Control

Automated machines used by industry are operated by systems of control, which include electrical, mechanical, hydraulic and pneumatic control – this requires engineers to have a sound understanding of the processes and theory which underpin the operation of these machines.

The aim of this unit is for your students to develop a foundation of knowledge and understanding of how these control systems work.

Students will gain an understanding of mechanisms used in control systems, and how their design can deliver the desired motion and performance. They will be able to develop their knowledge of electric motor types commonly used in automation control, and how their construction relates to output characteristics.

Students will gain an understanding of simple hydraulic control systems, including valves and actuators, and a basic understanding of fluid transmission. They will also gain an understanding of simple pneumatic control systems.

Unit 16
Systems and Programming

Industrial automation control systems are run by engineers who can program them to perform the tasks needed in industries such as manufacturing or power generation. These engineers need an understanding of programming methods and techniques in the specific context of industrial control systems.

The aim of this unit is for your students to develop an understanding of these programming techniques, and the ability to program Programmable Logic Controllers (PLCs) (including the principles of ladder logic programming), and other embedded devices for a control system.

They will also gain an understanding of commercial validation strategies for automation control programs, and the levels and types of testing carried out.

Unit 17
Computer Aided Manufacture (CAM)

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 your students 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.

Unit 18
Lean and Quality

Striking an effective balance between efficiency of production and quality of product without compromising either is fundamental to the commercial success of engineering companies.

The aim of this unit is for your students to develop their understanding of the principles behind lean manufacturing and apply their understanding to a manufacturing context in terms of improving quality, eliminating waste and improving productivity.

They will also learn about a wide range of quality control, assurance and management techniques including mathematical analysis of quality data to identify trends and recommend subsequent improvements to processes or procedures.

They will apply the knowledge and understanding gained to the development production plans, factory layouts and manufacturing processes.

Unit 19
Inspection and Testing

In ensuring that the business can meet the demands of its customers when manufacturing and supplying goods, suppliers must inspect and test these goods and products prior to completion, to guarantee their levels of quality. Dependent on the product type and process used to manufacture, there are a number of methods which can be used.

The aim of this unit is for your students to develop an understanding of different methods of inspection and testing (including both destructive and non-destructive testing). They will learn how the use of these methods contributes to quality control, and how defects can form in manufacturing components, processes and materials in the first place.

They will also learn about how automatic testing and inspection techniques are used in engineering.

Unit 20
Business for Engineering

Whatever areas of engineering you look at, businesses which operate within them need to be commercially viable and constantly reviewing and developing what they do in order to survive in a globally competitive market place.

The aim of this unit is for your students to develop your understanding of how engineering businesses of all sizes survive, develop and manage the different constraints on their activities, through innovation, entrepreneurship and investment. They will learn about project management tools and develop an understanding of financial planning techniques and financial analysis in an engineering context.

Unit 21
Maintenance

Maintenance, and maintenance engineering, are vital for all other aspects of engineering to function. From basic vehicle maintenance, to the increasingly complex devices, equipment, machinery and structures that are used in modern industry, the role of maintenance in keeping everything operating at optimum performance is crucial.

The aim of this unit is to develop your students knowledge and understanding of different maintenance strategies and operations, then to be able to plan and undertake maintenance operations themselves.

They will also be able to analyse maintenance data, develop an understanding of failure modes, and an understanding of how maintenance issues can inform future design.

Unit 22
Engineering and the Environment

Environmental issues and sustainability are crucial in modern engineering. From legislative, regulatory and ethical perspectives, minimising the impact of engineering on the environment is a high priority.

The aim of this unit is for you to develop your students understanding of how engineering impacts on the environment. By the end of the unit they should be able to evaluate how environmental concerns both constrain and drive engineering activities, and how engineering has developed to keep up with these demands against the backdrop of globalisation and global manufacturing.

Unit 23
Applied Mathematics for Engineering

Once the key mathematical techniques needed for engineering are learnt, they need to be applied to engineering problems. Understanding mathematics in an applied engineering context is what distinguishes the engineer from the pure mathematician.

The aim of this unit is to extend and apply the knowledge your students gained in Unit 1 Mathematics for Engineering. It is therefore strongly recommended that they have completed Unit 1 Mathematics for Engineering prior to commencing the study of this unit.

By completing this unit students will:

- be able to apply trigonometry and geometry to a range of engineering situations
- be able to apply knowledge of algebra, equations, functions and graphs to engineering problems
- be able to use calculus to analyse a range of problems
- understand applications of matrix and vector methods
- be able to apply mathematical modelling skills.

Unit 24
Project Management for Engineers

Engineering organisations undertake projects of all kinds that may vary in terms of purpose and scope. Some examples of engineering projects include designing a new or replacement product, utilising new technology to improve an existing product or service, utilising new materials, lowering wastage, improving the production process, setting up bespoke production or improving the quality or quantity of output from mass production. A project comprises a range of tasks and activities to be carried out in a particular sequence in order to reach an intended purpose. Being able to prepare and manage a project is an important skill needed by many different people working in engineering and manufacturing organisations.

In this unit your students will learn about the stages of project management, and the type of skills a project manager should have. They will learn about the importance of project planning and how to use a range of project planning tools. They will be made aware of internal and external factors which might have an impact on the planning, implementation and closure of a project. They will learn why you need to monitor the progress of a project through to implementation and closure. In addition, students will learn the importance of measuring the success of a project and how lessons learned can feed into future projects.

The failure of engineering projects to deliver on time and on cost has jeopardised the future of many businesses, large and small. Engineers who combine their subject expertise with project management are better positioned to contribute to the overall success of the organisation. For this reason, engineers with knowledge and expertise in effective project management is a skill which employers value highly.

Unit 25
Promoting Continuous Improvement

The best engineers follow the principle that they must be committed to maintaining high standards of work in every aspect. This means that engineers should continually be looking to improve the standards and quality of their work.

It is very unusual to see a successful engineer using just one or two of the techniques they have developed. Rather it is the combination and appropriate use of skills, knowledge and techniques from a range of areas that distinguishes the successful engineer. These should be used alongside the principles of continuous improvement and total quality management (TQM).

In this unit your students will learn how to take the different skills and tools developed in the course to date and use them to raise the standards and quality of their work. They will use a system, process or artefact they have engineered during a practical activity from units that they have already completed, they will use what they have learned in the qualification to modify it in some way. By modify this means that students might look to make aesthetic improvements, use improved production method, use alternative materials or carry out production for a revised purpose.

This unit will help students to develop the skills required to recognise and combine their engineering learning to achieve a better outcome.

YOUR JOURNEY WITH US...

Our aim is to support you on your journey with us – from initial enquiry right through to results day.

To get you off on the right foot you might want to take advantage of the customer support we provide for Cambridge Technicals.

Welcome process

All brand new Cambridge Technical centres will receive a welcome email to get you off on the right foot.

This will support you with locating on-line resources and training that's right for you, and make sure you have everything you need to start your journey with us.

Cambridge Technical introductory welcome videos

We have a number of support videos you can watch at your leisure. The 2016 Cambridge Technical introductory video provides you with an overarching guide to the suite and our wrap-around resources and customer support offer.

Each of the 2016 Level 3 Cambridge Technicals has a subject introductory video that guides you through each qualification size; including the structure, information on the externally assessed units, and our flexible internal assessment that puts your student at the heart of the process.

Advisory support

If your centre is intending to deliver or has already started delivering Cambridge Technicals, but would like some additional support, you can take advantage of our Advisory Support services.

Advisory Support covers a variety of topics such as: entry and assessment administration, qualification structure, *assessment methods, teaching and learning materials, and delivery ideas.

We provide our support in a range of different ways. This includes downloadable teaching and assessment materials, support videos, live online Q&A sessions, and face to face CPD.

*Please note that one thing we can't do is look at live student work.

CPD Training Events

We also provide INSET events; these are offered on various dates and locations throughout the UK. On our CPD Hub **www.cpdhub.ocr.org.uk** you can take a look at the courses, find out what the aims and objectives of the course are, and book your place. For those of you who are new to the qualification we'd suggest attending 'getting to know the specification'. This will provide an introduction to the qualification structure, assessment model, resources, support and guidance on delivery, and assessment requirements for the mandatory units.

On the CPD Hub you can also find all the materials that are provided to delegates on the day. So, if you can't attend a face-to-face event… don't worry, you can still download the materials free of charge.

Assignment Checking Service

To support your internal assessment we'll provide a model assignment for every mandatory unit in the specification. You can use these with your students, adapt it to meet your local environment, or use it as a basis to create your own assignment.

Because of the vocational nature of Cambridge Technicals, we believe that allowing you to create assignments that meet your students' needs and interests will benefit them more and give them greater success. Your assessment assignments should reflect the practical nature of the units, and your students should really feel what it's like to work in the sector.

But... if you're unsure, an Assignment Checking Service is available, and can be accessed through the CPD hub on our website; however it's not mandatory for assignments to be endorsed by OCR. We'll check your centre set assignment for you and provide feedback before you use it with your students.

Online Community

If you want to interact with other tutors you could try our online community.

Of course, online communities are only as good as the members who contribute to them. Within a virtual professional development community you can share and swap ideas for delivery, post questions, support others, suggest ideas for employer engagement, and share links to other teaching and learning resources.

TEACHING, LEARNING AND ASSESSMENT SUPPORT

Teaching and Learning Materials	In addition to our face-to-face support, we also provide a range of materials to assist you in your teaching and assessment. This will include:
Rule of Combination Calculator	An Excel based tool to help you make sure students select the right number and combination of units for their chosen qualification.
Progress Tracker	An Excel based tracking tool to help you monitor students' progress throughout the qualification.
Delivery Guide	A range of lesson ideas with associated activities you can use with students to deliver the content of the unit.
Lesson Elements	Task sheets and accompanying instructions for some of the activities within the unit Delivery Guide.
Resource Link	An e-resource providing you with a range of links to teaching and learning websites and materials.
Project Delivery Resources	Whole projects designed to ensure holistic teaching coverage of the content of each vocational pathway.
Skills Guide	A range of generic skills guides coving topics such as Communication, Research Skills, and Exam Techniques.

Internal assessment

The majority of the qualification content will be internally assessed through centre-set assignments created by you. We'll provide you with a range of model assignments across the qualification for you to use or adapt where necessary. Alternatively, you can create your own assignment to reflect your local area and needs that are relevant to your centre; plus you can use our Assignment Checking Service to make sure you're on the right lines.

Visiting moderation

For the internally assessed units we provide two free visiting moderation visits per academic year. At these visits we will be able to provide you with supportive feedback, advice and guidance.

Sample Learner Work

We know that you like to make sure your students are on the right track and working towards gaining the best possible outcome they can.

We can't look at your students' live work, but the CPD Hub has a range of sample learner work for Cambridge Technicals.

Sample learner work is just that... a sample; it's not exemplary or a 'gold standard'. The work has been looked at by our Lead Moderator and in many cases they've provided a commentary on how the work stacks up against the assessment criteria, or have annotated the script to show which assessment criteria have been met. This should help you get a feeling for what is expected, and how your students are getting on – you may also find the command verb resource useful too; this can be found on the qualification page of the OCR website.

External assessment

We're working with subject experts to make sure that for externally assessed units we create assessment solutions that retain the vocational nature of the qualification and be relevant for the sector. External assessment across the Cambridge Technicals suite could involve written examinations including case studies, pre-release materials, controlled projects or tasks, or computer based tests relating to the subject which students will need to apply their knowledge and understanding to.

More information about each units external assessment can be found in the qualification Centre Handbook.

External assessment will be set and marked by us; there will be two opportunities for your students to take them, in January and June, so you can decide when they are ready to take their assessment.

Sample Assessment Materials

We have produced Sample Assessment Materials for each externally assessed unit. This will provide you with an idea of the type of assessment for each unit and give the opportunity for your students to practice.

Combined Past Paper

This resource is a combination of:

- Past Paper
- Mark Scheme
- Examiner Comments

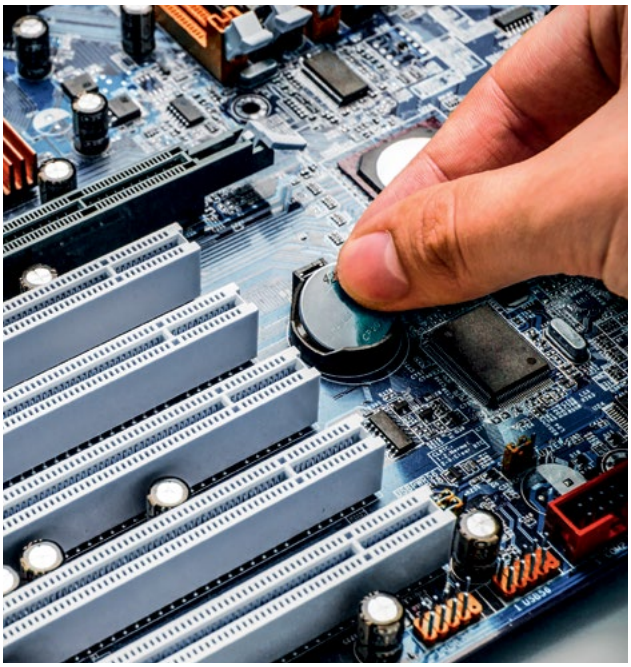
Following each exam series, we'll produce a Combined Past Paper so you can see the paper, alongside the mark scheme and examiner comments to demonstrate how students responded and where improvements could have been made.

Student Textbooks

Support your teaching of the new Cambridge Technicals 2016 suite with textbooks, developed in partnership between OCR and Hodder Education; the resources cover each specialist pathway for every subject and ensure your ability to deliver a flexible course that is both vocationally focused and academically thorough.

OCR Oxford Cambridge and RSA | HODDER EDUCATION LEARN MORE

Working in partnership to deliver quality resources



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**

OCR is part of the Cambridge Assessment Group, a department of the University of Cambridge.

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