BTEC Level 3 Nationals in Engineering, Electrical and Electronic Engineering, Mechanical Engineering, Computer Engineering, Manufacturing Engineering and Aeronautical Engineering: Comparing unit content between the 2010 and 2016 qualifications

Introduction

This document is designed to help you with mapping unit content as you transition from BTEC Nationals (2010) qualifications to the new BTEC Nationals (2016).

Our guidance is broken down into two sections:

Section 1: How and where can I use existing content, and what new content has been included?
Highlighting comparable content with the BTEC Nationals (2010) and how closely this maps across to the BTEC Level 3 Nationals (2016).

Section 2: What do these changes mean for planning and teaching?
Review of key changes in language, outlining which units are externally assessed and when, and where to find further support.

Further support can also be found within the relevant specification on our website (here).

Below is an overview of how wider support also links to this document:

Support	Purpose
Delivery Plans	Examples of how to structure and deliver different size qualifications over a one or two year period, including when to prepare learners for external assessment.
Authorised Assignment Briefs	Provides scenarios and teaching plans for each unit, to be used either as they are set out, or to inform your own planning.
Schemes of Work	Demonstrates how the unit content can be covered in the GLH while providing lesson ideas and highlighting links to other units to help you plan your teaching.
Sample Assessment Materials	Examples of how an externally assessed unit may be presented, with an accompanying mark scheme. These sample assessment materials have been developed to support this qualification and will be used as the benchmark to develop the assessment students will take. This covers either an exam or task.
Sample Marked Learner Work	Indicative examples of learner work which has been assessed accurately to national standards.

Section 1: How and where can I use the existing (2010) content, and what new content has been included?

Headlines

It should be noted that whilst there are considerably less units available for the 2016 qualifications, the areas of study are generally similar although amended and/or restructured. The content has been updated in most units and there are several new units (such as Units 17 and 45), as well as a new pathway (Computer Engineering: Units 32-35 and 37-38). All of the internally assessed units are 60 GLH, which will align with centres' experience of delivering BTEC Engineering at this level. The three externally assessed units (1, 3 and 6) are 120 GLH and mandatory (Unit 6 is only mandatory for the Extended Diploma size).

At a glance

Examples of QCF units linked to the 2016 pathways (not including the mandatory 2016 units – see below):

BTEC Level 3 (2016)	BTEC Level 3 (2010)
Engineering	10, 11-14, 15-19, 20-23, 26-29, 31-33, 34-37, 43-45, 50, 52-53, 57-58, 61, 63, 134, 146
Electrical and Electronic Engineering	11-12, 15, 19, 21-22, 26, 28, 34-37, 44, 50, 52-53, 57-58, 61, 63
Mechanical Engineering	11-14, 15-23, 26-28, 35-37, 44-45, 50, 53, 57, 61, 134
Computer Engineering	11, 12, 15-17, 21, 26, 28, 31, 34-37, 44-45, 50, 52-53, 57, 61, 63
Manufacturing Engineering	10-12, 15-19, 20-23, 26-29, 31-37, 43-45, 50, 63, 134, 146
Aeronautical Engineering	10, 13-17, 21, 23, 26-28, 35-37, 44-45, 50, 61, 63, 66, 69, 71-72, 79, 80-81, 83-85, 134, 146

In more detail

The tables below compare the relevant content of the Level 3 BTEC Nationals in Engineering (2016) against the content of the Level 3 BTEC Nationals in Engineering (2010).

The mapping focuses on the units that are mandatory across all of the 2016 pathways, and provides greater detail associated with where content is fully covered when mapped against the QCF (2010) specifications, and also where content is partially covered.

<table>
<tr><th>2016</th><th>2010</th></tr>
<tr><td colspan="2">Unit 1: Engineering Principles</td></tr>
<tr><td colspan="2">Comments/Details:
This new unit is mandatory for all pathways/sizes. It is externally assessed and, in terms of assessment, has no direct equivalent unit in the QCF.

Nonetheless, all of the topics can be directly mapped to Learning Outcomes (LO) from QCF units:
4: Mathematics for Engineering Technicians
5: Mechanical Principles and Applications
6: Electrical and Electronic Principles
11: Further Mechanical Principles and Applications
64: Further Electrical Principles</td></tr>
<tr><td colspan="2">A: Algebraic and trigonometric mathematical methods</td></tr>
<tr><td>A1 Algebraic methods

A2 Trigonometric methods</td><td>Fully covered in:
Unit 4, LO1 – Be able to use algebraic methods
Indices and logarithms
Linear equations and straight line graphs
Factorisation and quadratics
Unit 4, LO2 – Be able to use trigonometric methods and standard formulae to determine areas and volumes
Circular measure
Triangular measurement
Mensuration</td></tr>
<tr><td colspan="2">B: Static engineering systems</td></tr>
<tr><td>B1 Static engineering systems

B2 Loaded components</td><td>Partially covered in:
Unit 5, LO1 – Be able to determine the effects of loading in static engineering systems
Non-concurrent coplanar force systems
Simply supported beams
Loaded components</td></tr>
<tr><td colspan="2">C: Dynamic Engineering Systems</td></tr>
<tr><td>C1 Dynamic engineering systems</td><td>Partially covered in:
Unit 5, LO2 – Be able to determine work, power and energy transfer in dynamic engineering systems
Kinetic parameters
Kinetic principles
Dynamics parameters
Dynamic principles</td></tr>
</table>

	Unit 11, LO4 – Be able to determine the operating characteristics of lifting machines *Parameters of lifting machines* *Lifting machines*
D: Fluid and thermodynamic engineering systems	
D1 Fluid systems D2 Thermodynamic systems	**Partially covered** in: Unit 5, LO3 – Be able to determine the parameters of fluid systems *Thrust on a submerged surface* *Immersed bodies* *Flow characteristics of a gradually tapering pipe* Unit 5, LO4 – Be able to determine the effects of energy transfer in thermodynamic systems *Heat transfer* *Thermodynamic process equations*
E: Static and direct current electricity and circuits	
E1 Static and direct current electricity E2 Direct current circuit theory E3 Direct current networks	**Partially covered** in: Unit 6, LO1 – Be able to use circuit theory to determine voltage, current and resistance in direct current (DC) circuits *DC circuit theory* *DC networks* Unit 6, LO2 – Understand the concepts of capacitance and determine capacitance values in DC circuits *Capacitors* *Charging and discharging of a capacitor* *DC network that includes a capacitor* Unit 64, LO2 – Understand the transient behaviour of resistor-capacitor (RC) and resistor-inductor (RL) DC circuits *Transient behaviour of RC circuit* Unit 64, LO3 – Be able to apply single-phase alternating current (AC) theory *Series R, L and C alternating current (AC) circuits*
F: Magnetism and electromagnetic induction	
F1 Magnetism	**Partially covered** in: Unit 6, LO3 – Know the principles and properties of magnetism *Magnetic field* *Electromagnetic induction*
G: Single-phase alternating current	
G1 Single-phase alternating current theory	**Partially covered** in: Unit 6, LO4 – Be able to use single-phase alternating current (AC) theory *Single phase AC circuit theory*

<table>
<tr><th>2016</th><th>2010</th></tr>
<tr><td colspan="2">Unit 2: Delivery of Engineering Processes Safely as a Team</td></tr>
<tr><td colspan="2">Comments/Details:
This new unit is mandatory for all pathways/sizes. It is internally assessed and has some direct links with a number of QCF units:
1: Health and Safety in the Engineering Workplace
16: Engineering Drawing for Technicians
17: Computer Aided Drafting in Engineering
77: Human Factors in Aircraft Engineering

Some of the ‘New content’ does have some links with the QCF units stated below; however, none of these topics can be directly mapped to LOs in the QCF units.</td></tr>
<tr><td colspan="2">Learning aim A: Examine common engineering processes to create products or deliver services safely and effectively as a team</td></tr>
<tr><td>A2 Health and safety requirements

A3 Human factors affecting the performance of engineering processes</td><td>Partially covered in:
Unit 1, LO1 – Understand the key features of health and safety legislation and regulations
Key features of legislation and regulations
Unit 77, LO2 – Understand how various human limitations and behaviours can affect performance
Human limitations
Behaviour</td></tr>
<tr><td colspan="2">New content:
A1 Common engineering processes – some links with QCF units, for example:
2: Communications for Engineering Technicians
20: Engineering Primary Forming Processes
21: Engineering Secondary and Finishing Techniques
22: Fabrication Processes and Technology
52: Electrical Installation
69: Aircraft Workshop Principles and Practice</td></tr>
<tr><td colspan="2">Learning aim B: Develop two-dimensional computer-aided drawings that can be used in engineering processes</td></tr>
<tr><td>B1 Principles of engineering drawing

B2 2D computer-aided drawing</td><td>Partially covered in:
Unit 16, LO2 – Be able to interpret engineering drawings that comply with drawing standards
Drawing standards
Unit 16, LO3 – Be able to produce engineering drawings
Detail drawings of single-piece engineering components
Circuit diagrams
Unit 16, LO4 – Be able to produce engineering drawings using a computer aided drafting (CAD) system
Prepare a template
Produce engineering drawings
Store and present engineering drawings</td></tr>
</table>

	Unit 17, LO3 – Be able to produce and interpret CAD drawings *CAD drawings* *Commands*
Learning aim C: Carry out engineering processes safely to manufacture a product or to deliver a service effectively as a team	
C3 Health and safety risk assessment	**Fully covered** in: Unit 1, LO2 – Know how to identify and control hazards in the workplace *Within the workplace* *Working environment* *Hazards which become risks* Unit 1, LO3 – Be able to carry out a risk assessment and identify control measures *Risk assessments* *Use of control measures* Unit 1, LO4 – Understand the methods used when reporting and recording accidents and incidents *Principles* *Recording and reporting procedures*
New content: C1 Principles of effective teams – some links with QCF unit: 43: Teamwork in a Continuous Improvement Environment C2 Team set-up and organisation – some links with QCF unit: 43: Teamwork in a Continuous Improvement Environment C4 Preparation activities for batch manufacture or batch service delivery – some links with QCF units, for example: 2: Communications for Engineering Technicians 16: Engineering Drawing for Technicians 29: Manufacturing Planning C5 Delivery of manufacturing or service engineering processes – some links with QCF units, for example: 19: Mechanical Measurement and Inspection Techniques 20: Engineering Primary Forming Processes 21: Engineering Secondary and Finishing Techniques 22: Fabrication Processes and Technology 52: Electrical Installation 53: Electronic Measurement and Testing 69: Aircraft Workshop Principles and Practice	

2016	2010
Unit 3: Engineering Product Design and Manufacture	
Comments/Details: This new unit is mandatory for all pathways/sizes. It is externally assessed and, in terms of assessment, has no direct equivalent unit in the QCF. This unit is synoptic; as a result, several of the topics can be mapped to LOs from a number of the QCF units: 2:Communications for Engineering Technicians 4: Mathematics for Engineering Technicians 8: Engineering Design 9: Commercial Aspects of Engineering Organisations 10: Properties and Applications of Engineering Materials 12: Applications of Mechanical Systems in Engineering 16: Engineering Drawing for Technicians 20: Engineering Primary Forming Processes 21: Engineering Secondary and Finishing Techniques 22: Fabrication Processes and Technology 29: Manufacturing Planning	
A: Design triggers, challenges, constraints and opportunities, and materials and processes	
A1 Design triggers A4 Material properties A5 Mechanical power transmission A6 Manufacturing processes	**Partially covered** in: Unit 8, LO1 – Know how the design process operates when dealing with customers *The design process* Unit 10, LO2 – Know material properties and the effects of processing on the structure and behaviour of engineering materials *Mechanical properties* *Physical properties* *Thermal properties* *Electrical and magnetic properties* *Effects of post-production use* *Effects of processing metals* *Effects of processing thermoplastic polymers* *Effects of processing thermosetting polymers* *Effects of processing ceramics* *Effects of processing composites* *Effects of post-production use* Unit 10, LO4 – Know about the modes of failure of engineering materials *Principles of ductile and brittle fracture* *Principles of fatigue* *Principles of creep* Unit 12, LO1 – Know about the purposes and uses of lubricants and lubrication systems

	Lubricant purposes and types Unit 12, LO3 – Know about the uses and operation of mechanical power transmission systems *Cams and linkage mechanisms* Unit 20, LO1 – Know how moulding techniques involving metals, ceramics and polymers are used *Moulding techniques involving metals* *Moulding techniques involving ceramics* *Moulding techniques involving polymers* Unit 20, LO2 – Know how deformation processes involving metals and polymers are used *Deformation processes involving metals* *Deformation processes involving polymers* Unit 20, LO3 – Know how shaping and assembly processes involving composites are used *Composite shaping processes* *Composite assembly processes* Unit 21, LO1 – Understand how a range of secondary machining techniques are used *Turning* *Milling* *Boring* *Grinding* *Presswork* Unit 21, LO4 – Know how finishing techniques are used *Hot processes* *Plating methods* Unit 22, LO3 – Know how materials are formed and assembled to produce fabricated structures *Assembly* Unit 29, LO1 – Know the techniques and policies used to improve product manufacturing efficiency *Types of production*
New content: A2 Design challenges A3 Equipment level and system level constraints and opportunities	
B: Interpreting a brief into operational requirements and analysing existing products	
B1 Design for a customer B2 Regulatory constraints and opportunities	**Partially covered** in: Unit 8, LO1 – Know how the design process operates when dealing with customers *Customer* *Product design specification (PDS)* Unit 8, LO2 – Understand the impact of legislation, standards and environmental and manufacturing constraints on the design function *Legislation and standards* *Environmental and sustainable constraints*

	Manufacturing constraints Unit 9, LO2 – Know about competitive commercial activities *Intellectual rights* Unit 9, LO3 – Know about local and national constraints *Statutory controls* *Kitemark systems*
New content: B3 Market analysis B4 Performance analysis B5 Manufacturing analysis	
C: Using an iterative process to design ideas and develop a modified product proposal	
C1 Design proposals C2 Communicating designs	**Partially covered** in: Unit 2, LO1 – Be able to interpret and use engineering sketches/circuit/network diagrams to communicate technical information *Interpret* *Engineering sketches/circuit/network diagrams* Unit 2, LO2 – Be able to use verbal and written communication skills in engineering settings *Written work* Unit 2, LO3 – Be able to obtain and use engineering information *Information sources* *Use of information* Unit 8, LO3 – Be able to prepare design proposals that meet the requirements of a product design specification *Requirements of a PDS* *Prepare design proposals* *Design reference material* Unit 8, LO4 – Be able to produce and present a final design solution *Final design solution* *Presentation techniques* Unit 16, LO1 – Be able to sketch engineering components *Sketches* *Sketching techniques* Unit 16, LO2 – Be able to interpret engineering drawings that comply with drawing standards *Interpret*
New content: C3 Iterative development process	
D: Technical justification and validation of the design solution	
D1 Statistical methods	**Partially covered** in: Unit 4, LO3 – Be able to use statistical methods to display data *Data handling* *Statistical measurement*
New content: D2 Validating designs	

2016	2010
Unit 4: Applied Commercial and Quality Principles in Engineering	
Comments/Details: This new unit is mandatory for all pathways/sizes, other than the Extended Certificate. It is internally assessed and some of the topics can be mapped to LOs from the following QCF units: 7: Business Operations in Engineering 9: Commercial Aspects of Engineering Organisations 42: Quality and Business Improvement Techniques	
Learning aim A: Examine business functions and trade considerations that help engineering organisations thrive	
A1 Business functions and key activities A2 Trade considerations A3 Competitive advantage	**Partially covered** in: Unit 7, LO1 – Understand how an engineering company operates *Engineering functions* Unit 9, LO1 – Know about the business planning and corporate expectations of an engineering organisation *Business planning considerations* Unit 9, LO2 – Know about competitive commercial activities *Tendering and contracting* *Intellectual rights* *Innovation*
Learning aim B: Explore activity-based costing as a method to control costs and to determine if an engineering product or service is profitable	
B1 Reasons for cost control and types of costs B2 Activity-based costing method	**Partially covered** in: Unit 7, LO4 – Be able to apply costing techniques to determine the cost effectiveness of an engineering activity *Costing techniques* *Make-or-buy decisions*
Learning aim C: Explore how engineering organisations use quality systems and value management to create value	
C1 Quality systems C2 The principles and processes of value management	**Partially covered** in: Unit 9, LO4 – Know about the concepts of quality assurance and quality control *Quality* *Quality assurance* *Quality control* Unit 42, LO1 – Be able to apply the principles and processes of value management *Principles* *Value analysis*

2016	2010
Unit 5: A Specialist Engineering Project	
Comments/Details: This new unit is mandatory for all pathways/sizes, other than the Extended Certificate and Foundation Diploma. It is internally assessed and some of the topics can be mapped to LOs from the following QCF units: 2: Communications for Engineering Technicians 3: Engineering Project	
Learning aim A: Investigate an engineering project in a relevant specialist area	
A1 Project life cycle A2 Project idea generation and solution development A3 Feasibility study of solutions	**Partially covered** in: Unit 2, LO2 – Be able to use verbal and written communication skills in engineering settings *Written work* *Verbal methods* Unit 2, LO2 – Be able to obtain and use engineering information *Information sources* *Use of information* Unit 3, LO1 – Be able to keep records, specify a project, agree procedures and choose a solution *Project records* *Initial concepts* *Specification* *Procedures* *Techniques* Unit 3, LO2 – Be able to plan and monitor a project *Planning* Unit 3, LO3 – Be able to implement the project plan within agreed procedures *Implement* *Checking solutions*
Learning aim B: Develop project-management processes and a design solution for the specialist engineering project as undertaken in industry	
B1 Planning and monitoring project-management processes B3 Technical specification B4 Design information	**Partially covered** in: Unit 2, LO2 – Be able to use verbal and written communication skills in engineering settings *Written work* *Verbal methods* Unit 2, LO2 – Be able to obtain and use engineering information *Information sources* *Use of information* Unit 3, LO1 – Be able to keep records, specify a project, agree procedures and choose a solution *Project records* *Specification* Unit 3, LO2 – Be able to plan and monitor a project *Planning*

	Monitoring Unit 3, LO3 – Be able to implement the project plan within agreed procedures *Implement* *Checking solutions* Unit 3, LO4 – Be able to present the project outcome *Project report*
New content: B2 Risk and issue project-management processes	
Learning aim C: Undertake the solution for a specialist engineering project and present the solution as undertaken in industry	
C1 Undertake and test the solution to the problem C2 Demonstration of relevant behaviours C3 Present a solution to the problem	**Partially covered** in: Unit 2, LO2 – Be able to use verbal and written communication skills in engineering settings *Written work* *Verbal methods* Unit 2, LO2 – Be able to obtain and use engineering information *Information sources* *Use of information* Unit 3, LO1 – Be able to keep records, specify a project, agree procedures and choose a solution *Project records* *Specification* Unit 3, LO3 – Be able to implement the project plan within agreed procedures *Implement* *Checking solutions* Unit 3, LO4 – Be able to present the project outcome *Presentation* *Project report*

2016	2010
Unit 6: Microcontroller Systems for Engineers	
Comments/Details: This new unit is mandatory for all pathways, but only for the Extended Diploma size. It is externally assessed and, in terms of assessment, has no direct equivalent unit in the QCF. Several of the topics can be mapped to LOs from the following QCF units: 50: Industrial Process Controllers 59: Microprocessor Systems and Applications 65: Principles and Applications of Microcontrollers	
A: Investigate typical microcontroller system hardware	
A1 Control hardware A2 Input devices A3 Output devices A4 Selecting hardware devices and system design A5 Assembling and operating a microcontroller system	**Partially covered** in: Unit 50, LO3 – Know about the types and operation of programmable logic controllers (PLCs) *System hardware and software* *External input and output devices* Unit 59, LO1 – Know how microprocessor-based systems can be applied *Microprocessor system applications* Unit 59, LO2 – Understand the architecture and operation of a microprocessor system *Architecture* *Principles of operation* Unit 59, LO4 – Be able to use a microprocessor development system to prepare and run a program *Enter, assemble, download, run and test a program* Unit 65, LO2 – Understand microcontroller communication interfaces and human interface devices *Interfaces* *Human interface devices* Unit 65, LO3 – Understand microcontroller hardware control methods *Real-time operating system (RTOS)* *Control instructions* Unit 65, LO4 – Be able to select, implement and test a microcontroller *Selection and implementation*
B: Programming Techniques and Coding	
B1 Programming techniques B2 Coding constructs B3 Structured program design	**Partially covered** in: Unit 50, LO4 – Be able to write and fault-find programmable logic controller programs *PLC instructions* *Test and debug programs* Unit 59, LO3 – Understand decimal, binary and hexadecimal number systems, instructions and subroutines

B4 Number systems	*Number systems* *Instruction groups* *Subroutines and the stack* Unit 59, LO4 – Be able to use a microprocessor development system to prepare and run a program *Program operations* *Enter, assemble, download, run and test a program* Unit 65, LO4 – Be able to select, implement and test a microcontroller *Testing techniques*
C: System development cycle	
New content: C1 Development processes C2 Documentation	

2016	**2010**
Unit 7: Calculus to Solve Engineering Problems	
Comments/Details: This new unit is mandatory for all pathways, but only for the Extended Diploma size (it is an optional unit for the Foundation Diploma and the Diploma sizes). It is internally assessed and most of the topics can be mapped to LOs from the following QCF units: 4: Mathematics for Engineering Technicians 28: Further Mathematics for Engineering Technicians	
Learning aim A: Examine how differential calculus can be used to solve engineering problems	
A1 Functions, rate of change, gradient A2 Methods of differentiation A3 Numerical value of a derivative A4 Second derivative and turning points	**Partially covered** in: Unit 4, LO4 – Be able to use elementary calculus techniques *Differentiation* Unit 28, LO4 – Be able to apply calculus *Differentiation*
Learning aim B: Examine how integral calculus can be used to solve engineering problems	
B1 Integration as the reverse/inverse of differentiation B2 Integration as a summating tool B3 Numerical integration	**Partially covered** in: Unit 4, LO4 – Be able to use elementary calculus techniques *Integration* Unit 28, LO4 – Be able to apply calculus *Integration*

Learning aim C: Investigate the application of calculus to solve a defined specialist engineering problem	
C4 Solution implementation	**Partially covered** in: Unit 28, LO4 – Be able to apply calculus *Differentiation* *Integration*
New content: C1 Thinking methods C2 Mathematical modelling of engineering problems C3 Problem specification and proposed solution	

Section 2: What do these changes mean for planning and teaching?

Main benefits

- The BTEC National Extended Diplomas in Engineering (all pathways) are the only large (3 A-level equivalent) qualifications successfully developed for the DfE 16-19 Tech-Level performance measures
- A wide choice of specific engineering pathways (Electrical/Electronic, Mechanical, Computer, Manufacturing, Aeronautical) for the Diploma (720 GLH) and Extended Diploma (1080 GLH) qualifications
- The Foundation Diploma is the only engineering qualification successfully developed for the DfE 16-19 Applied General performance measures that is 540 GLH (to reflect the common Further Education 1/2 year delivery model)
- The suite includes units that form part of the knowledge qualifications for a number of the new engineering-based apprenticeships
- All qualifications carry UCAS points
- Funded for 19+ learners

What are the key changes that I need to be aware of?

Different language used for delivery

You can find a glossary of key terms and command verbs for both the internally and externally assessed units:

Internally assessed units – Appendix 2 within the specifications, found here

Externally assessed units – here

An example of where the key terms have changed is below:

2016 **Unit 4: Applied Commercial and Quality Principles in Engineering**	**2010** **Unit 7: Business Operations in Engineering** **Unit 9: Commercial Aspects of Engineering Organisations** **Unit 42: Quality and Business Improvement Techniques**
The pass criteria require learners to 'Explain', 'Produce' and 'Complete'.	The pass criteria mainly require learners to 'Identify', 'Define', 'Outline', 'Describe', 'Carry out' and 'Use'.

Which units are being externally assessed?

Unit	First assessment window
1: Engineering Principles	May/June 2017
3: Engineering Product Design and Manufacture	May/June 2017
6: Microcontroller Systems for Engineers	May/June 2018

How should I plan delivery of these units to reflect the changes in assessment?

More guidance on delivery models can be found within the 2016 BTEC Nationals Delivery Guide and Delivery Plans.

These documents are available on the website within the 'course materials' section for all the Engineering pathways (accessible here)