Unit 41: Electrical Installation Design in Building Services Engineering

Unit code: F/600/0416

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to give learners a knowledge of the principles and processes, and skills, used in the design of electrical services for buildings. Learners will also develop knowledge and skills in data distribution, security and fire protection system requirements.

Unit introduction

Building services engineers need to develop an understanding of industry standards and how they relate to the principles and processes used to design the electrical services used in buildings.

This unit considers the application of components, materials, equipment and installation methods to the production of design specifications for lighting, power, data distribution, security and fire protection systems within buildings.

This unit focuses on linking electrical and lighting principles with practical applications. The unit should, therefore, be undertaken when learners have either achieved an understanding of the associated electrical science, materials and analytical methods or have begun to study them.

Learning outcomes

On completion of this unit a learner should:

1 Know how to design electrical lighting and power requirements for buildings

2 Be able to design electrical lighting and power installations for specific applications

3 Know how to establish the data distribution, security and fire protection system requirements

4 Be able to design data distribution, security and fire protection installations for specific applications.

Unit content

1 Know how to design electrical lighting and power requirements for buildings

Design: specification; information

Design specification: lighting and power; commercial installations; industrial installations; public sector installations; client requirements; user requirements; environmental considerations; locations with special requirements

Design information: standards; legislation

Lighting: principles; lamps and luminaires

Lighting principles: standard units; illumination levels; relationship to tasks; glare rating; inverse square law of illumination; cosine law of illumination; lumen calculation for number of luminaires for artificial light installations; spacing ratios; glare assessment and prevention

Lamps and luminaires: operational features and characteristics of lamps; efficacy, stroboscopic effect and re-strike time; operational features and characteristics of luminaires; classification; output ratios, ingress protection; photometric performance; applications; switching arrangements; zoning of lighting

Power requirements: installation, short circuit and overload protection; current carrying capacity

Power installation: identification of small and fixed power requirements; number and location of socket outlets and other power outlets; identification of electrical loads for mechanical plant; cable routing, distribution; location of distribution boards and equipment; load centres; load balancing; determining maximum demand; diversity

Short circuit and overload protection: prospective short-circuit current (PSC); operating time; backup protection; short circuit; overcurrent and combined protection, discrimination

Current carrying capacity: method of installation; operating temperatures; correction factors for ambient temperature, grouping; thermal insulation, semi-enclosed fusing; combination of grouping factors; cable sizing; cable rating and voltage drop for short circuit and overload protection

2 Be able to design electrical lighting and power installations for specific applications

Design: lighting (lamps and luminaires); power installations; drawings to support designs

Lamps and luminaires: lamps and luminaries for particular applications; cables and wiring systems; switching arrangements; lighting zones; cable routing

Power installation: suitable circuit arrangements; cables and wiring systems; number and location of socket outlets and other power loads; cable routing, distribution; location of distribution boards and equipment

Drawings: layout; schematic; detail; graphical symbols; distribution board/equipment schedules

3 Know how to establish the data distribution, security and fire protection system requirements

System requirements for: data distribution, security and fire alarm installations in commercial, industrial and public sector applications; client, user and environmental requirements and considerations; locations with special requirements; design information eg relevant standards, legislation and guides; risk assessments for security and fire protection systems for a building

Data distribution systems: data signals; serial and parallel data transmission; high-level data link control; LAN and WAN networks; network configurations eg bus, tree, ring, mesh and star; horizontal and vertical distribution; structured cables for communication; clean and dirty earths; earth loops; category 5 and 6 installations; cable types; links to other systems eg fire, security and BMS

Security systems: access control; types of detectors and their application; open and closed circuits

Fire protection systems: types of automatic detectors and their operation; choice of detectors; manual call points; suitability of cables; stand-alone smoke detectors; control and indicating equipment

4 Be able to design data distribution, security and fire protection installations for specific applications

Design for specific applications: data distribution; security; fire protection; drawings to support designs

Data distribution installations: network and network configurations; distribution and earthing systems; types of cables and wiring systems; cable routing

Security system installations: access control equipment; types of detectors; types of circuits; types of cables and wiring systems; cable routing; types of alarm/control panels

Fire protection system installation: detectors; manual call points; types of circuits; types of cables and wiring systems; cable routing; control and indicating equipment

Drawings: layout; schematic; detail; graphical symbols; distribution board/equipment schedules

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 identify the lighting, small power, fire protection, security and data requirements for buildings [IE2, IE4, IE6, SM2, SM3, SM5]	**M1** compare alternative lamps, luminaires and switching arrangements, making appropriate recommendations for specific applications	**D1** evaluate the procedures and calculations used to size cables for use in lighting and small power systems
P2 identify relevant standards and select design conditions [IE2, IE4, IE6, SM2, SM3, SM5]		
P3 identify the power requirements for a building to determine maximum demand [IE2, IE4, IE6, SM2, SM3, SM5]		
P4 describe the operational features and applications of lamps and luminaries [IE2, IE4, IE6, SM2, SM3, SM5]		
P5 produce a lighting installation design [IE2, IE4, IE6, SM2, SM3, SM5]	**M2** produce comprehensive design calculations for lighting and small power installations	**D2** justify the design rationale used in the production of a lighting and power design for a given client and their building.
P6 produce a power installation design [IE2, IE4, IE6, SM2, SM3, SM5]		
P7 produce annotated lighting drawings to include switching arrangements, cable routes and types of wiring systems [IE2, IE4, IE6, SM2, SM3, SM5]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 produce annotated small power drawings to include cable routes and types of wiring systems [IE2, IE4, IE6, SM2, SM3, SM5]		
P9 produce distribution board schedules [IE2, IE4, IE6, SM2, SM3, SM5]		
P10 describe the operational characteristics of data network distribution, security and fire protection systems, equipment and cabling [IE2, IE4, IE6, SM2, SM3, SM5]	**M3** evaluate given installation drawings, design calculations and manufacturer's data for security, data distribution and fire protection systems in terms of cost and performance-in-use.	
P11 produce annotated data distribution, security and fire protection drawings [IE2, IE4, IE6, SM2, SM3, SM5]		
P12 produce component lists and distribution board schedules. [IE2, IE4, IE6, SM2, SM3, SM5]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practical work, research using the internet and/or library resources and use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the subject relevance.

This unit can be delivered as a stand-alone package but it would be preferable to integrate it with other electrical units to produce a more holistic approach to building services. Although the focus is on the design of electrical installations within buildings, there is a strong link with the unit *Electrical Installation Standards and Components in Building Services Engineering* in relation to practical applications. An understanding of the unit *Electrical Principles in Building Services Engineering* gained before starting this unit would be an advantage.

Activity-based learning is encouraged, including case studies, site visits and product investigations.

Group activities are permissible, but tutors will need to ensure that individual have equal experiential assessment opportunities.

Health, safety and welfare issues are paramount and should be reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken before practical activities are taken. Centres are advised to read the *Delivery approach* section in the specification, and *Annexe H: Provision and Use of Work Equipment Regulations 1998 (PUWER).*

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to unit content
Whole-class teaching: design specification, establishing requirements and specification for lighting and power installations in commercial, industrial and public sector applications, client, user and environmental requirements and considerations, locations with special requirements, design information; identification of relevant standards and legislation
Whole-class teaching: standard lighting units, illumination levels, relationship to tasks, glare rating, inverse square law of illumination, cosine law of illumination, lumen calculation for number of luminaires for artificial light installations, spacing ratios, glare assessment and prevention, lamps and luminaires, operational features and characteristics of lamps, efficacy, stroboscopic effect and re-strike time
Small-group work on operational features and characteristics of luminaires, classification, output ratios, ingress protection, photometric performance, selection of lamps and luminaries for particular applications, switching arrangements, zoning of lighting
Each group to make a small presentation, tutor to comment, support and amend where necessary and provide a comprehensive handout to support the exercise
Visit to site or college workshops to see electrical installation work in progress

Topic and suggested assignments/activities and/assessment
Whole-class teaching: identification of small and fixed power requirements, number and location of socket outlets and other power outlets, identification of electrical loads for mechanical plant, cable routing, distribution, location of distribution boards and equipment, load centres, load balancing, determining maximum demand, diversity, short circuit and overload protection, prospective short-circuit current (PSC), operating time, backup protection, short circuit, overcurrent and combined protection, discrimination, current carrying capacity; method of installation; operating temperatures, correction factors for ambient temperature, grouping; thermal insulation, semi-enclosed fusing, combination of grouping factors, cable sizing, determination of cable rating and voltage drop for short circuit and overload protection Individual learner work on cable sizing for given installations
Assignment 1: Lighting and Power Requirements
Whole-class teaching: selection of lamps and luminaries for particular applications, cables and wiring systems, switching arrangements, lighting zones, cable routing, circuit arrangements, number and location of socket outlets and other power loads, distribution, location of distribution boards and equipment Visit to site or college workshops to see how design affects electrical installation work Individual learner work to produce drawings including layout, schematic, detail drawings, graphical symbols, distribution board/equipment schedules
Assignment 2: Design of Lighting and Power Systems
Whole-class teaching: establishing the requirements and specification for data distribution, security and fire alarm installations in commercial, industrial and public sector applications, client, user and environmental requirements and considerations, locations with special requirements, identification of relevant standards, legislation and guides, risk assessments to identify the security and fire protection requirements for a building, data systems and signals, serial and parallel data transmission, high-level data link control, LAN and WAN networks, network configurations – bus, tree, ring, mesh and star, horizontal and vertical distribution; structured cables for communication, clean and dirty earths, earth loops, category 5 and 6 installations, cable types, links to other systems – fire, security and BMS, access control, types of detectors and their application, open and closed circuits, fire protection systems, types of automatic detectors and their operation, choice of detectors, manual call points, suitability of cables, stand-alone smoke detectors, control and indicating equipment Visit to site or college workshops to see relevant installation work in progress
Whole-class teaching: data system installation, selection of suitable network and network configurations, distribution and earthing systems, types of cables and wiring systems, cable routing, security system installation – select suitable access control equipment, types of detectors, types of circuits, types of cables and wiring systems, cable routing, types of alarm/control panels Small-group work on fire protection installation: select suitable detectors, manual call points, types of circuits, types of cables and wiring systems, cable routing; control and indicating equipment Each group to make a small presentation, tutor to comment, support and amend where necessary and provide a comprehensive handout to support the exercise Individual learner work to produce drawings including layout, schematic, detail, graphical symbols, distribution board/equipment schedules
Assignment 3: Data Distribution, Security and Fire Protection Systems
Review of unit and assignment feedback

Assessment

Evidence can be produced from a single, well-designed, realistic project based on an electrical installation for a real building. In practice it may be easier for learners if assessment is divided into three discrete assignments. The first assignment could relate to P1, P2, P3, P4, M1 and D1, the second to P5, P6, P7, P8, P9, M2 and D2 and the third to P10, P11, P12 and M3. If a single building is to be used as the basis for delivery and assessment then it should have a wide variety of uses, functions, activities and features that will give learners the opportunity to consider options and make decisions. It is important that the selected building is not too complex and should be capable of realistically incorporating conventional final circuits and other items of fixed plant. Alternatively, evidence may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical work. Architectural drawings of a professional standard, that meet current building design standards, should be provided to allow learners to extract information.

There are many suitable forms of assessment that could be used and tutors are encouraged to consider and adopt these where appropriate. Some example assessment approaches are suggested below. However these are not intended to be prescriptive or restrictive and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable.

Some criteria can be assessed directly by the tutor during practical activities. If this format is used then suitable evidence would be observation records or witness statements.

Learners should complete their evidence in formal reports, design calculations and drawings, either written or electronic. Oral presentations may be used where appropriate.

Although this unit functions effectively in a stand-alone capacity, it is strongly recommended that, where learners are studying other related units concurrently, assessment evidence is coordinated to avoid unnecessary duplication. In such situations, centres may wish to consider the use of integrative assignments. For example, assessments associated with standards and components, inspection testing and commissioning, control applications and so forth can be integrated within the assessment instruments designed to meet the grading criteria for this unit.

To achieve a pass grade, the learner must meet the 12 pass criteria listed in the grading criteria grid.

For P1, learners must identify the lighting, small power, fire protection, security and data requirements for buildings. For areas requiring artificial lighting, learners should determine appropriate lighting levels and glare rating, supported by the sources of reference and factors used in their selection. For areas requiring small power, learners must determine the number of portable and fixed socket outlets whilst identifying locations that are likely to require, for example three-phase or extra low voltage supplies and those which impose a higher risk or hazardous environment. For areas requiring fire protection and security learners must carry out a relevant risk assessment to identify suitable levels of protection. For areas requiring data provision, learners must identify the number of data points required. Evidence must extend beyond the mechanistic use of standard tables and the building specified for assessment must contain locations where a degree of judgement is required of learners.

For P2, learners must identify relevant standards and select design conditions. They should interpret a design brief to select suitable parameters whilst identifying appropriate British and European standards.

For P3, learners must identify the power requirements for a building to determine the maximum demand. This should include any power requirements from the lighting, fire alarm, security and data system designs.

For P4, learners must describe the operational features and applications of lamps and luminaires. They should describe how different characteristics contribute to the selection process for specific applications.

For P5, learners must produce a lighting installation design. This must include all necessary calculations, supported by relevant copies of manufacturer's literature/data sheets.

For P6, learners must produce a power installation design. This must include all necessary calculations, supported by relevant copies of manufacturer's literature/data sheets.

For P7, learners must produce annotated lighting drawings to include switching arrangements, cable routes and types of wiring systems. Use of a suitable computer-aided design package is preferable but hand annotations of architects' drawings is acceptable provided they are legible. Current drawing symbols must be used throughout.

For P8, learners must produce annotated small power drawings to include cable routes and types of wiring systems. Use of a suitable computer-aided design package is preferable but hand annotations of architects' drawings is acceptable provided they are legible. Current drawing symbols must be used throughout.

For P9, learners must produce distribution board schedules. This should include suitable types and ratings of protective devices. Use of a suitable tabular or spreadsheet format is preferred.

For P10, learners must describe the operational characteristics of data network distribution, security and fire protection systems, equipment and cabling. This should include information on the different types of systems available.

For P11, learners must produce annotated data distribution, security and fire protection drawings to include cable routes and types of wiring systems. Use of a suitable computer-aided design package is preferable but hand annotations of architects' drawings is acceptable provided they are legible. Current drawing symbols must be used throughout.

For P12, learners must produce component lists and distribution board schedules to support the drawings produced for P11.

To achieve a merit grade, the learner must meet all the pass grade criteria and the three merit grade criteria.

For M1, learners must make comparisons between alternative lamps, luminaires and switching arrangements making appropriate recommendations for specific applications. They should relate their decisions to the needs of particular clients and buildings and must outline any constraints and environmental considerations. This is a natural extension of the work carried out for P1, P2 and P4.

For M2, learners must produce comprehensive design calculations for lighting and small power installations. This could be a natural extension of the work carried out for P5 to P9.

For M3, learners must evaluate given installation drawings, design calculations and manufacturer's data for lighting, small power, data, security and fire alarm installations. The designs should include details of all items used in data, fire alarms and security. Learners should relate their decisions to the needs of particular buildings and the proposed systems, giving reasons for equipment/system selection and outlining any constraints and considerations. They are also expected to use appropriate data to carry out any calculations. This could be a natural extension of the work carried out for P10 to P12.

To achieve a distinction grade, the learner must meet all the pass grade criteria, the merit grade criteria and the two distinction criteria.

For D1, learners must evaluate the procedures and calculations used to size low voltage power and lighting cables. This should include live and protective conductors and the results should show all working, with clear details of from where the relevant data was obtained

For D2, learners must justify the design rationale used in the production of a lighting and power design for a given client and their building, demonstrating how the proposed design meets the needs of the building, the client and the end users, as well as the wider issues of environmental impact. As part of the justification, they are expected to link the features of the design with appropriate underpinning principles.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, D1	Lighting and Power Requirements	The electrical installation design department has requested that you provide a training manual to be used by trainee building services engineers. This comes in three parts and should be used to link design practice to good installation practice. The first part should deal with lighting and power requirements. Exemplar calculations should be included throughout.	Report, accompanied by sketches, drawings, graphs, charts, tables, specifications, calculations and text as appropriate.
P5, P6, P7, P8, P9, M2, D2	Design of Lighting and Power Systems	As above but the focus is on design.	Report, accompanied by sketches, drawings, graphs, charts, tables, specifications, calculations and text as appropriate.
P10, P11, P12, M3	Data Distribution, Security and Fire Protection Systems	As above but for data distribution, security and fire protection systems.	Report, accompanied by sketches, drawings, graphs, charts, tables, specifications, calculations and text as appropriate.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Construction and the Built Environment sector suite. This unit has particular links with the following unit titles in the Construction and the Built Environment suite:

Level 1	Level 2	Level 3
		Building Services Control Systems
		Electrical Principles in Building Services Engineering
		Electrical Installation Standards and Components in Building Services Engineering
		Commissioning Electrical Installations in Building Services Engineering

This units links with the Level 3 NVQ in Technical Design (Construction Environment). It also links to the following National Occupational Standards at Level 3:

- BE Design
- Construction Contracting Operations.

Essential resources

Learners will need access to a range of publications, reference data, manufacturers' products/information, approved test instruments and computer facilities. Centres should work closely with major building services contractors in order to add realism and relevance to the project work.

Centres should have access to a wide range of hard copy or online technical and manufacturers' literature.

The use of readily available visual aids, such as examples of lamps and luminaires, would be advantageous.

Centres should have access to sets of architectural drawings, electrical installation and schematic drawings to support the learning process and facilitate assessments. These could be in hard copy or electronic format. Where these drawings are used as part of the assessment process, it is recommended that repeated use of the same building is avoided in order to maintain the freshness of the assessment process.

Employer engagement and vocational contexts

Support to enable centres to initiate and establish links to industry, and to networks arranging visits to industry and from property practitioners is given below:

- Learning and Skills Network – www.vocationallearning.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Summit Skills – www.summitskills.org.uk
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei/

Indicative reading for learners

Textbooks

Chartered Institute of Building Services Engineers – *Guide K: Electricity in Buildings* (CIBSE Publications, 2004) ISBN 190328726X

IEE (Institution of Electrical Engineers) – *Requirements for Electrical Installations (IEE Wiring Regulations), 17th Edition* (IET, 2008) ISBN 9780863418440

IEE (Institution of Electrical Engineers) – *On-site Guide (EBS7671:2008 Wiring Regulations), 17th Edition* (IET, 2008) ISBN 9780863418549

IEE (Institution of Electrical Engineers) – *Electrical Installation Design Guides: Calculations for Electrician's and Designers)* (IET, 2008) ISBN 9780863415500

Scaddan B – *Wiring Regulations: Design & Verification of Electrical Installations, 17th Edition* (Newnes, 2008) ISBN 0750687215, 9780750687218

Scaddan B – *Electrical Installation Work, 5th Edition* (Newnes, 2005) ISBN 0750666196, 97807506666190

Stokes G – *Handbook of Electrical installation Practice: 4th Edition* (Blackwell Publishing, 2003) ISBN 0632060026, 9780632060023

Whitfield JF – *Electrician's Guide to the 17th Edition BS7671:2008 and Part P of the Building Regulations* (EPA Press, 2008) ISBN 0953788555, 9780953788552

Journals

Electrical and Mechanical Contractor – Electrical Contractors' Association

Professional Electrician and Installer – Hamerville Magazines Ltd

Websites

www.elecsa.org.uk	Electrical Contractors' Association
www.enginuity.org.uk	Engineering resources
www.jib.org.uk	Joint Industry Board for the Electrical Contracting Industry
www.jtltraining.com	Training in the electrical sector
www.scenta.co.uk	Engineering and technology careers and news
www.sectt.org.uk	Scottish Electrical Charitable Training Trust
www.semta.org.uk	Sector Skills Council for Science, Engineering and Manufacturing Technologies
www.summitskills.org.uk	Sector Skills Council for the Building Services Engineering Sector

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	• assimilating and analysing information provided by drawings and clients briefs • making decisions and exercising judgement on calculated values • using information to identify appropriate plant and equipment • identifying sources of information to facilitate the design process • exercising judgement and reasoning in comparing the different types of plant and equipment • analysing data to select plant and equipment • analysing manufacturer's data in relation to selecting plant and equipment • exercising judgement and reasoning in comparing the different types of manufacturer's information • analysing data to produce plant schedules and drawings
Self-managers	• showing initiative, commitment and perseverance whilst working towards meeting assignment completion deadlines • organising time and resources and prioritising actions in order to meet assignment completion deadlines • dealing with the pressures of meeting assignment completion deadlines whilst also coping with work-related demands

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using a range of software programs, including internet and intranet resources, in the centre, home or the workplace, to produce information for reports and assignments
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	using time management systems in the centre, home or in workplace
Manage information storage to enable efficient retrieval	opening, using and saving report and assignment files
Follow and understand the need for safety and security practices	limiting time spent at computers and following 'correct use of computer' guidelines recognising the purpose of virus-check software
Troubleshoot	overcoming ICT system problems when researching information for, or producing reports or assignments, in the centre or workplace
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	using a range of software programs, including internet and intranet resources, to produce information for reports and assignments
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	making decisions to select information for the production of reports and assignments whilst recognising the need for correctly referenced material, the requirements for data protection and avoiding plagiarism
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	organising and structuring information to produce formatted information for reports and assignments
Bring together information to suit content and purpose	producing formatted information for reports and assignments
Present information in ways that are fit for purpose and audience	presenting information to produce formatted information for reports and assignments
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	using email communication with tutors and/or work colleagues

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	analysing calculation data
Identify the situation or problem and the mathematical methods needed to tackle it	performing lighting design calculations
Select and apply a range of skills to find solutions	performing calculations to determine cable voltage drop and thermal constraints
Use appropriate checking procedures and evaluate their effectiveness at each stage	conducting ongoing analysis of calculated values
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	including answers to calculations in reports and assignments
Draw conclusions and provide mathematical justifications	analysing calculated values in reports and assignments
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	taking part in class discussions and answering questions taking part in workplace-related reviews and presentations to line managers
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching course notes and other documents for information to produce formatted information for reports and assignments responding to written queries and instructions in the workplace
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	presenting written information in reports and assignments producing written answers to queries and instructions in the workplace