Higher National Unit Specification

General information for centres

Unit title: Lighting Design in Buildings

Unit code: DV9L 34

Unit purpose: This Unit has been designed to allow candidates to develop the skills required to design lighting systems for buildings in compliance with the current Chartered Institution of Building Services Engineers (CIBSE) recommendations. It also allows candidates to develop the necessary underpinning knowledge and understanding of light energy and the factors to be considered when selecting the luminaires for given conditions. In addition, the Unit is also designed to develop the candidate's knowledge and understanding of emergency lighting systems and their requirements in accordance with current British Standards.

On completion of the Unit the candidate should be able to:

1 Explain the fundamental principles of lighting design.
2 Describe the operating characteristics of lamps and luminaries.
3 Design a general lighting system for given conditions.
4 Design an emergency lighting system for given conditions.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Entry is at the discretion of the Centre, however candidates should have a broad knowledge and understanding of the installation of electrical wiring systems, and electrical engineering principles. This may be evidenced by the possession of the following HN Units: DG5434 Single-Phase AC Circuits, Application of Electrical and Electronic Instruments, Inspection and Testing of Low Voltage Electrical Installations, and Electrical Safety and the following NQ Units: D9AG 11 Basic Electrical Installation Systems and Protection, and the NQ qualification C06C 11 Electrical Installation Fundamentals.

Core Skills: There are opportunities to develop the Core Skills of Critical Thinking at SCQF level 6, Using Number at SCQF level 5 and Using Graphical Information at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

General information for centres (cont)

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: The assessment for Outcomes 1 and 2 of this Unit could be done on an Outcome by Outcome basis although it is recommended that the assessment be combined together into one assessment paper. This paper could be taken by candidates at one single assessment event that should last 1.5 hour. The assessment paper should be composed of a suitable balance of short answer, restricted response and structured questions. This assessment should be conducted under controlled, supervised conditions.

Outcomes 3 and 4 of this Unit should each be assessed by means of a project-based lighting design assignment in which candidates are provided with sufficient information to permit the design of the required lighting systems ie a general lighting system for Outcome 3 and an Emergency lighting system for Outcome 4.

It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

Higher National Unit specification: statement of standards

Unit title: Lighting Design in Buildings

Unit code: DV9L 34

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the fundamental principles of lighting design

Knowledge and/or skills

- Visible light wavelength within the electromagnetic spectrum
- Lighting terms
- Inverse square and cosine laws
- Luminous intensity distribution diagrams
- Reflection

Outcome 2

Describe the operating characteristics of lamps and luminaries

Knowledge and/or skills

- Luminaire classification by light distribution
- Colour rendering of lamp types
- Glare and glare index
- Construction, operation and applications of lamp types

Evidence Requirements

Evidence for the knowledge and/or skills of Outcomes 1 and 2 will be provided on a sample basis. The evidence may be provided in response to specific questions and the assessment will be conducted under supervised, closed-book conditions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment, **three out of five** knowledge and/or skills items for Outcome 1 and **two out of the first three bullet point** knowledge and/or skill items and **two lamp types** from the last bullet point of the knowledge and/or skill item for Outcome 2 should be sampled.

Higher National Unit specification: statement of standards (cont)

Unit title: Lighting Design in Buildings

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of three out of five knowledge and/or skills items for Outcome 1 and two out of the first three bullet point knowledge and/or skills items for Outcome 2 along with a different sample of two lamp types for the last bullet point knowledge and/or skill item of Outcome 2 is required each time the Unit is assessed. Candidates must provide a satisfactory response to all items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

Outcome 1

- define the visible light wavelength within the electromagnetic spectrum
- define lighting terms
- apply the inverse square and cosine laws
- draw luminous intensity distribution diagrams (Polar Curves) for a given luminaire
- define specular, spread and mixed reflection

Outcome 2

- describe luminaire classification by light distribution
- explain colour rendering of lamp types
- describe glare and glare index
- describe the construction, operation and applications of lamp types including General Lighting Service (GLS) tungsten, tungsten halogen, fluorescent, high-pressure sodium discharge, high-pressure mercury discharge

Assessment guidelines

The assessment for Outcomes 1 and 2 could be combined together to form one assessment paper. This single assessment paper should be taken at a single assessment event lasting 1.5 hours and carried out under supervised, closed-book conditions. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

This assessment should be carried out under supervised and controlled conditions

Outcome 3

Design a general lighting system for given conditions

Knowledge and/or skills

- Lumen method of interior lighting design
- Selection of luminaires
- 'Glare Index'
- Production of designed lighting scheme

Higher National Unit specification: statement of standards (cont)

Unit title: Lighting Design in Buildings

Evidence Requirements

Evidence for the knowledge and /or skills of Outcome 3 is provided by an assignment on the designs of an electric lighting system. Each candidate will be provided with a specification for a room including (i) its intended function (ii) its dimensions (iii) the height of working surfaces above floor level.

The candidate will determine an appropriate illumination level on the working surfaces for the given room specification. Using manufacturer's data sheets/specifications for luminaries and appropriate illumination data, the candidate will determine the lumen output rating of luminaries required to maintain the required surface illumination level and will design an appropriate lighting system.

The assignment should ensure that the evidence provided is sufficient to meet the requirements for each knowledge and/or skill item by showing that the candidate is able to:

Outcome 3

- apply the Lumen method of interior lighting design
- select, from manufacturer's data, appropriate luminaires for the lighting scheme
- calculate the 'Glare Index' of the lighting design and ensure that this is acceptable
- produce a design report for the designed lighting scheme including an appropriate luminaire distribution plan

Assessment guidelines

The candidate should be provided with the assignment specification at the commencement of the delivery of Outcome 3. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

The design scheme report should be of approximately 500 -750 words plus calculations, diagrams and appendices which should cover the Knowledge and/or Skill requirements of Outcome 3.

Centres should make every reasonable effort to ensure the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter.

Outcome 4

Design an emergency lighting system for given conditions

Knowledge and/or skills

- 'Emergency lighting' terms
- Maintained and non-maintained systems
- Requirements of current 'Standards' for emergency lighting
- Emergency lighting scheme

Higher National Unit specification: statement of standards (cont)

Unit title: Lighting Design in Buildings

Evidence Requirements

Evidence for the knowledge and /or skills of Outcome 4 is provided by an assignment on the designs of an emergency lighting scheme. Each candidate will be provided with a specification for a small public premises including (i) its intended function (ii) its floor area (iii) the position of and routes to emergency exits.

The candidate will determine the appropriate illumination levels for general area lighting and escape lighting and, using manufacturer's data sheets/specifications for luminaries and appropriate illumination data, will design an emergency lighting scheme including the number and type of luminaries required to meet general and escape lighting requirements and to provide sufficient exit signage.

The assignment should ensure that the evidence provided is sufficient to meet the requirements for each knowledge and/or skill item by showing that the candidate is able to:

Outcome 4

- define 'emergency lighting' terms
- describe maintained and non-maintained emergency lighting systems
- describe the requirements of current British Standards relating to emergency lighting
- produce an emergency lighting scheme

Assessment guidelines

The candidate should be provided with the assignment specification at the commencement of the delivery of Outcome 4. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

The design scheme report should be of approximately 500 -750 words plus calculations, diagrams and appendices which should cover the Knowledge and/or Skills requirements of Outcome 4.

Centres should make every reasonable effort to ensure the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter.

Administrative Information

Unit code: DV9L 34

Unit title: Lighting Design in Buildings

Superclass category: TJ

Date of publication: August 2005

Version: 01

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Lighting Design in Buildings

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow candidates to develop their knowledge and competence in the following areas:-

1 Explain the fundamental principles of lighting design.
2 Describe the operating characteristics of lamps and luminaries.
3 Design a general lighting system for given conditions.
4 Design an emergency lighting system for given conditions.

This Unit was developed for the Advanced Certificate in Electrical Engineering/HNC Engineering Practice. Assessment is built in to the suggested time for each Outcome.

1 Explain the fundamental principles of lighting design (8 hrs)

This Outcome is intended to provide the underpinning knowledge and understanding upon which the lighting design is based. It begins with the fundamental principle of light energy and its place in the electromagnetic spectrum. It then introduces the candidate to lighting terminology and definitions and, from this, considers how light energy is radiated from luminaires and reflected from various surfaces.

- Definition of the visible light wavelength within the electromagnetic spectrum
- Definition of lighting terms including:
  - luminous intensity
  - luminous flux
  - illumination
  - luminance
  - lumen
  - direct ratio and room index and the relationship between them
  - (BZ Classification)
  - flux fraction
  - flux fraction ratio
  - light output ratio (upward and downward)
  - luminous area
- Application of the inverse square and cosine laws
- Distribution of Luminous Intensity (Polar diagrams)
- Specular reflection, spread reflection and mixed reflection.

2 Describe the operating characteristics of lamps and luminaires (10 hrs)

This Outcome considers the operating characteristics of various types of lamps and luminaires. It considers how luminaires are classified in terms of their light output distribution and develops the important factors of colour rendering and glare. The Outcome should then explain the construction and operation of various lamp types and discuss the applications for which they are most suitable:

- Description of luminaire classification by light distribution ie direct, semi-direct, general diffusing, semi-indirect, indirect.
- Colour rendering of various lamp types and colour-rendering index.
- Glare: Disability glare, discomfort glare and glare index
- Description of the construction, operation and applications of lamp types to include: General Lighting Service (GLS) tungsten, tungsten halogen, fluorescent, high-pressure sodium discharge, high-pressure mercury discharge.

3 Design a general lighting system for given conditions (12 hrs)

This Outcome is intended to develop the candidate's ability to apply the Lumen method for calculating the required illumination for a lighting scheme and, from this and using commercial luminaire data sheets, to select the required type, rating and number of luminaires for the lighting design scheme. The glare index of the lighting design should also be calculated and compared with the limiting value recommended in the CIBSE code for interior lighting. The candidate should then produce a lighting design report which specifies the number of luminaires required, type and rating of luminaires used, the spacing of luminaires, their colour rendering index and the acceptability of glare from the lighting design.

- Application of the Lumen method of interior lighting design.
- Selection, from manufacturer's data, of appropriate luminaires for the lighting scheme.
- Calculation of the 'Glare Index' of the lighting design and ensuring that this is acceptable.
- Production of a written design report for the designed lighting scheme including an appropriate luminaire distribution plan.

Note: It would be beneficial to candidates if they were given the opportunity to use commercially produced software to check their design recommendations.

4 Design an emergency lighting system for given conditions (8 hrs)

This Outcome should introduce the candidate to emergency lighting systems and the features of their design. Candidates should be introduced to emergency lighting terminology and to the reasons for including emergency lighting in the design of building services. The main requirements of relevant British Standards should be highlighted and the design of an emergency lighting scheme to meet these requirements should be developed:

Higher National Unit specification: support notes (cont)

Unit title: Lighting Design in Buildings

- Definition of 'emergency lighting' terms to include: Emergency Lighting, Emergency Lighting Systems, Escape Route Lighting, Open Area Lighting, Standby Lighting, Combined (sustained) Emergency Luminaire, Maintained Emergency Lighting, Non-maintained Emergency Lighting, Self-contained Emergency Luminaire (single Point), Slave Luminaire, Duration, Material Times.
- Description of maintained and non-maintained emergency lighting systems including simplified diagrams.
- Description of the requirements of current British Standards (Emergency Lighting) to include: Illumination for Safe Movement; minimum levels of illuminance, identification of exits and escape routes by signs.
- Emergency Lighting Design; mounting height of luminaires, spacing between luminaires, siting of essential escape lighting luminaires, siting of additional escape lighting luminaires, toilets, lobbies and closets, signs for exits and escape routes, mounting height of signs, illumination of signs, maintained operation, floating systems, maintained changeover system, non-maintained operation.
- Production of an emergency lighting scheme for a small public premises to meet the requirements of current British Standards.

Guidance on the delivery and assessment of this Unit

The delivery of this Unit should be candidate-centred with the emphasis placed on the requirements of the of the knowledge/skills elements.

Candidates will be required to understand the terminology used in lighting design and the reasons behind the design concepts for a general lighting scheme and for emergency lighting schemes. This requires the candidate to gain a high level of familiarity of the context in which the design requirements are being developed and the specific conditions in which they are being applied.

The assessment of the Unit should provide the candidate with opportunities to develop his/her understanding of the general and emergency lighting design.

Mention should be made of the use of software in modern lighting design projects and the candidates should, if possible, be given the opportunity to confirm their design results by this method.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skills of Critical Thinking at SCQF level 6, Using Number at SCQF level 5 and Using Graphical Information at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

This Unit may be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that the assessments are conducted under controlled, supervised conditions.

Higher National Unit specification: support notes (cont)

Unit title: Lighting Design in Buildings

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs,* which is available on SQA's website: **www.sqa.org.uk**.

General information for candidates

Unit title: Lighting Design in Buildings

This Unit has been designed to provide you with an opportunity to develop your knowledge and understanding of the design of both general and emergency lighting systems. If you already have some working knowledge of electrical installations, some of these design concepts may be familiar to you. If, on the other hand, this is your first contact with electrical installations, the Unit should provide you with an understanding of the design methods and their relationship to the relevant British Standards and CIBSE codes.

You will firstly be introduced to the terminology of lighting design and the basic principles of illumination. You will then consider various types of lamp, their construction, operation and applications. The design sections will then follow and you will be given the opportunity to design a general lighting scheme and also a scheme to meet the emergency lighting requirements of a small public premises

Outcome 1 introduces you to the concept of light as a form of energy and defines this energy in terms of its wavelength within the electromagnetic spectrum. It also provides you with some definitions of terms used in illumination and lighting design before considering how light is emitted from luminaires and how this emitted light reacts with various types of surface.

Outcome 2 concentrates on the operating characteristics of lamps and luminaires and how these are used in a lighting design. it considers how the light output from a lamp affects the perceived colour of objects and how the lighting design produces discomfort and disability glare for persons in the room. This Outcome also develops your ability to understand how various type of lamp are constructed and how they operate to produce a light output. You will also learn the most appropriate applications of various lamp types.

Outcome 3 provides you with an opportunity to design a general lighting scheme for a given set of circumstances. You will be given information relating to a room ie its dimensions and its intended use, and you will be able to develop your skills at designing a suitable lighting scheme for this application.

Outcome 4 introduces you to emergency lighting and allows you to discus the need for emergency lighting systems. It provides you with an understanding of the requirements of emergency lighting schemes in public places and enables you to design an emergency lighting scheme for a given set of circumstances.

Your knowledge of the content of Outcomes 1 and 2 will be assessed by means of a closed-book assessment. Outcomes 3 and 4 will each be assessed by projects in which you will be required to carry out simple design exercises to produce lighting schemes.