Unit 25: Building Services Control Systems

Delivery guidance

The focus of this unit should be on developing knowledge and understanding of the purpose and function of building services control systems as well as the operational characteristics of control components and devices.

Approaching the unit

Use drawings, illustrations, images, animations and video clips to explain the principles governing control systems and to help learners understand operational characteristics of control devices. Such resources are freely available online and can be easily incorporated into tutor presentations.

If possible, arrange site visits to a large project or to a manufacturing facility where learners can have first-hand experience of both electrical and mechanical control systems such as heating, ventilation, air conditioning, refrigeration and lighting. The number and frequency of such site visits will vary according to your delivery schedule and the availability of the site(s).

Try to involve local professionals and experts from the building services engineering design and construction sector, as guest speakers. This will help to enthuse learners as they gain an insight into current practices within the industry.

Develop a project brief, or adapt a case study or real design example, for use as a learning resource (ideally throughout the delivery of the unit). This will help learners to develop a holistic understanding of the subject.

This unit concentrates on different forms of technology applied to various mechanical and electrical building engineering services. Therefore, it would be appropriate to deliver this unit when learning on other building services units has happened or is happening alongside this unit.

Delivering the learning aims

Learning aim A focuses on the principles underpinning building control systems, such as control loops and control modes. Learners will develop an understanding of these principles, which will help them to appreciate operational features of devices and systems, as well as their purposes.

Throughout the delivery of this learning aim, engage learners with knowledge quizzes, paired and/or group activities, class discussions and presentations. These activities will provide opportunities for peer learning.

Introduce control loops and modes using animations, DVDs, examples, illustrations or web-based videos (see the 'Resources' section for ideas). Once the basic principles have been understood, learners can participate in more 'in-depth' group activities and class discussions. For example, they can comment on the rationale behind a specific control system in terms of its use and benefits.

Further activities may include independent research and small group presentations on control modes and the operational characteristics of various control systems.

Site visits are key to engaging learners. For example, an early visit to a site where a range of control systems is being installed will help to consolidate understanding of the content within learning aim A. The site visit will also reinforce learning about legislative requirements and approaches in providing building control systems.

Learning aims B and C could be delivered using a project-based approach. These learning aims deal with the application of the principles covered in learning aim A and are very practical in nature. Learners have to produce a complete system design and justify their selection of systems and components.

Introduce the various systems and control components, then use well-structured research tasks to deepen learners' understand. You could then introduce real-life case studies of large commercial or industry projects. Learners will need access to project drawings, manufacturer's specifications, design data and project reports to quote some examples. Contact the companies for such information; they are often more than willing to help.

If possible, arrange for a guest speaker to visit the centre, such as a site manager, design engineer or technical staff member working for local government. The guest speaker could share with learners some examples of current design and installation principles within the industry.

Ensure all appropriate safeguards are in place during the site visit, and coordinate with site staff in advance to ensure all parties are aware of the learning opportunities during the visit. Reinforce this learning in class, using project-related data.

Learners need to consolidate their knowledge through the use of case studies, which can include interesting problem-solving challenges. For example, you could ask learners to explore the challenges and impacts of using alternative types of sensors, actuators, controlled devices and controllers for specific building services installations. To provide access to more case studies, either approach companies for relevant information, or download examples from the web.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Understand the principles associated with building services control systems	**A1** Control loops **A2** Modes of control **A3** Operational features **A4** Purpose of control systems	Analyse a client brief in terms of the modes of control and operational features.
B Apply the principles of building services control systems and the function and operational characteristics of control systems	**B1** Generic functions **B2** Safety controls and functions of safety control systems **B3** Operational characteristics of control devices and components **B4** The role of the computer technology in control systems	Develop a control system for a scenario, from a set of criteria. As part of the solution, produce a specification for all elements of the installation.
C Develop an appropriate specification and schematic drawings for building services control systems	**C1** Control functions **C2** Control strategies **C3** Drawings	

Assessment guidance

There is a maximum of two summative assignments for this unit. The assignment briefs should be set within the context of a large building services engineering project, such as a commercial or an industrial building.

For learning aim A, give learners a case study containing adequate details about a building services control system, so they can justify the proposed control system as well as the use of various control components and their operational features. The justification must relate to the given case study, drawing on learners' experience and knowledge of the factors to consider in the design of any building services control system.

For learning aims B and C, include sufficient details so learners can produce a system design and justify their selection of systems and components. Involving local employers in the assessment or using an industry project will be beneficial for learners.

Submitted assessment evidence could be in the form of a project or an investigative report and a proposal. You could ask learners to include drawings, sketches, illustrations, manufacturers' data and a list of information sources used.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 27: Building Services Control Systems

Introduction

Introduce the unit using animations, DVDs, pictures, illustrations or web-based videos relating to the building services control systems used within the context of a large construction project.

Engage learners through knowledge quizzes, paired or group activities, class discussions and presentations, and guest speakers and site visits.

Develop a project brief within the context of a large building services engineering project, such as a commercial or an industrial building. Ensure the brief gives learners plenty of opportunities to collate evidence for assessment across all three learning aims. This brief could be based on a case study or project data obtained through any related industry links. After the initial delivery of each learning aim, use this project as a tool for application of the principles learned.

Well-organised site visits will be invaluable for the delivery of this unit. Timetable visits carefully to ensure learners have sufficient knowledge to benefit fully from the experience. The site visits for this unit could be run in conjunction with visits from other units. It is critical to coordinate with site staff in advance to confirm the:

- health and safety requirements
- types of control systems and components used
- extent to which site staff will be able to engage (project presentation, access to drawings, project data, etc.).

Learners could prepare checklists before the visits, so they can record details of the different components and processes relating to control systems. If it is difficult to find appropriate sites, use project examples from DVDs or other project data instead.

Learning aim A: Understand the principles associated with building services control systems

- The delivery of this learning aim will benefit from a site visit, so learners can examine the installation of building services control systems. If a visit is not possible, use online resources and video clips to enhance tutor-led presentations and classroom-based activities.

A1: Control loops

- Show how control loops work, using animations, DVDs, illustrations or web-based videos. Cover open, closed, single and multi-loops. Facilitate a class discussion on the benefits and drawbacks of each type.

A2: Modes of control

- Give learners a group research activity to find examples of each mode of control (e.g. two-position, proportional and integral controls). Ask them to summarise the key points and present their findings to the class, including any additional relevant information.

A3: Operational features

- Deliver a presentation on the operational features of control systems, using examples. Consider the performance of control systems in terms of speed, accuracy and reliability for different construction scenarios.

- Check learners' understanding using a knowledge quiz or question and answer (Q&A) session.
- Give learners a set of example project documents, including details of building control systems, design brief, design requirements and the final design. Put learners in small groups and give each group a specific topic from the unit content for this learning aim – for example, ask one group to identify the operational features of the given control system. All groups then share their findings. Facilitate a class discussion and provide any additional information as necessary, collating group notes for the class in a shared access folder.

A4: Purpose of control systems

- As part of the delivery of learning aim A4, learners are required to know the legislative requirements related to the use of control systems. Use a presentation to introduce relevant regulations, using the previous project data to provide examples of compliance. Then give learners summary handouts that include the key features of regulations, which learners could apply to the design brief.
- Lead a class discussion about the use and benefits of control systems. This could involve small group discussions, in which learners consider some 'What if?' scenarios to emphasise the need for suitable controls. Summarise the key points and include any additional information as necessary.
- Use a knowledge quiz to check learners' understanding before they begin to design systems. Use the same example project data and ask questions to assess learning so far. Provide model answers, ask learners to complete self-assessments and give them constructive and developmental feedback.
- To review learning across learning aim A, facilitate a class discussion, asking learners to justify the selection of systems and components for the example project. Learners can then summarise their feedback and expand on the key points as necessary.
- For the summative assessment, learners must analyse a client brief in terms of the modes of control and operational features. Give learners a case study containing adequate details about a building services control system, so they can justify the proposed control system as well as the use of various control components and their operational features. The justification must relate to the given case study, drawing on learners' experience and knowledge of the factors to consider in the design of any building services control system.

Learning aim B: Apply the principles of building services control systems and the function and operational characteristics of control systems

B1: Generic functions and B2: Safety controls and functions of safety control systems

- Start the delivery of learning aims B and C using a group research activity. Ask learners to work in small groups to research the functions of various control systems. Allocate a specific system to each group, taking guidance from the unit content in the specification. For example, one group could work on heating and ventilation control systems (e.g. temperature, humidity, air quality and flow), while another group could focus on lighting control systems (e.g. lighting levels, time and pollution). Ensure each group also researches the use of these control systems to protect building users from potential accidents and health issues, such as combustion, leak detection and carbon monoxide.
- All groups must produce a presentation to share their findings. Facilitate a class discussion after each presentation, including any additional information as necessary and collating group notes for the class in a shared access folder.

B3: Operational characteristics of control devices and components

- Deliver a presentation introducing the operational characteristics of control devices and components.
- Ask learners to work in groups to produce a poster about a given topic from the unit content. For example, one group could explore sensors while another considers actuators.
- Each group must present their poster to their peers. Use this opportunity to apply learning checks, summarise learner findings and include any additional information where necessary.

B4: The role of the computer technology in control systems

- If possible, arrange a guest speaker to enhance the delivery of this learning aim. This speaker could have a design, manufacturing or installation/maintenance background. The role of computer technology in control systems is a very broad subject, so prepare learners by giving them relevant reading materials that will help them to draft questions they can ask during the guest lecture. Ensure the guest speaker is aware of the unit content and the level of the qualification. Facilitate the guest lecture (capture it on video if possible) and collate the key information.
- Follow up with a Q&A session to answer any learner queries.
- Use a knowledge quiz to assess learners' understanding of control systems and components, drawing on the key points.

Learning aim C: Develop an appropriate specification and schematic drawings for building services control systems

For this learning aim, develop a design brief covering requirements for a commercial or industrial building, ensuring learners have opportunities to design systems at the appropriate level.

C1: Control functions and C2: Control strategies

- Ask learners to work in small groups to investigate suitable control strategies and functions alongside associated manufacturers' data. Each group must produce a detailed system design, including sensors, actuators and controllers, as well as all the relevant components. Ask learners to prepare and present their project schematic to the class, justifying their control strategy and schematic drawings.

C3: Drawings

- Support learners while they work to develop the systems and specifications, to ensure they use the correct terminology and style. Instruct them as to the best method to communicate detailed designs, including drawing symbols and the use of clear and concise annotation. This activity could also be conducted in one-to-one tutorials with the groups.
- Ask learners to present their complete designs and specifications to the class. Learners should be able to provide evidence of extensive research carried out to finalise their choices. Give constructive and developmental feedback.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 14: Low Temperature Hot Water Systems in Building Services
- Unit 26: Heating, Ventilation and Air Conditioning Design
- Unit 27: Plumbing and Fluid Behaviour in Building Services Engineering
- Unit 28: Electrical Principles and Electrical Installation Standards in Building Services Engineering.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Construction. Check the Pearson website at http://qualifications.pearson.com/endorsed-resources for more information as titles achieve endorsement.

Textbooks

- Burberry, P., *Mitchell's Environment and Services*, 8th edition, Routledge, 2013, ISBN 978-0-582-24521-1 – This book explains the principles and environmental considerations of service installations.
- Chartered Institute of Building Services Engineers, *CIBSE Guide H: Building control systems*, Routledge, 2019, ISBN 978-0-367-39818-7 – This book contains extensive details of modern control systems and relevant information technology.
- Hall, F. and Greeno, R., *Building Services Handbook,* 9th edition, Routledge, 2017, ISBN 978-1-138-24435-1 – This book covers all aspects of building services in a concise manner.
- Zaher, M., *Building Services*, CreateSpace Independent Publishing Platform, 2012, ISBN 978-1-478-22590-4 – A very good resource to help learners understand principles and operation of air conditioning, pumps, fans, blowers and plumbing.

Journals

- *Building Services & Environmental Engineer (BSEE)* (Datateam Business Media) – An industry journal published monthly, containing in-depth technical features on subjects relating to building services.
- *Building Services Engineering Research & Technology (BSERT)* (Sage Publishing) – CIBSE's quarterly journal, containing useful research relevant to all aspects of building services engineering.
- *P&H Engineering* (Chartered Institute of Plumbing and Heating Engineers (CIPHE)) – The CIPHE online journal, which covers a broad range of areas relating to plumbing and heating.

Videos

- 'Environmentally-friendly buildings and infrastructures' – This video from Siemens provides an overview of control systems. Visit the Siemens website and select the 'Company' tab, then 'About us', 'Businesses' You may wish to search YouTube for the following titles:
- Building Energy Management System Review (by AESCO PTY LTD)
- HVAC Controls Building Automation Systems (by Nakenterprise) – Explains the past, present and future of HVAC control systems.

Websites

- Chartered Institute of Building Services Engineers (CIBSE) – CIBSE is the professional body for building service engineers. This website contains information about codes, products and industry updates.
- Chartered Institute of Plumbing and Heating Engineers (CIPHE) – This website contains information about codes, products and industry updates.
- Modern Building Services (MBS) – This website covers a wide range of building services engineering sectors.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.