Unit 62: Heating, Ventilation and Air Conditioning (HVAC)

Unit code	**H/615/1524**
Unit level	**5**
Credit value	**15**

Introduction

The buildings we use in everyday life to live, work, study and socialise are becoming increasingly more complex in their design. As well as being subject to more stringent environmental emission targets, within these buildings the heating, ventilation and air conditioning (HVAC) systems play a vital role in maintaining the comfort of the occupants within the built environment.

This unit will introduce students to some of the most important HVAC systems and their supporting elements, and the underpinning science that is currently used in many different buildings around the world.

Subjects covered include: ventilation rates, systems, legislation, strategies and associated equipment. Also explored are topics such as air conditioning systems, cooling loads, psychrometric principles and processes, heating systems, fuels, combustion processes, boiler efficiency calculations and Building Management Systems (BMS).

On successful completion of this unit students will be able to explain the fundamental principles of HVAC systems and discuss the operational advantages of using BMS for maintaining the careful balance between ergonomic climate control and maximum economic efficiency.

Learning Outcomes

By the end of this unit students will be able to:

1. Explain the operating principles of non-domestic ventilation systems.
2. Explore the range of air conditioning systems.
3. Investigate the operational characteristics of non-domestic heating systems.
4. Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems.

Essential Content

LO1 **Explain the operating principles of non-domestic ventilation systems**

Ventilation systems:

Ventilation requirements: approved documents, requirements for occupants or processes

Ventilation strategies: local or centralised systems, natural ventilation, extract only, supply only and balanced systems

Ventilation system components and typical system layouts

Ventilation rates:

Calculation of ventilation rates, supply for occupants or processes, supply to achieve required room air change rate

Mass and volumetric flow rates to maintain design room conditions

Fans:

Fan types and operational characteristics

Fan selection and Fan Laws

LO2 **Explore the range of air conditioning systems**

Air conditioning systems:

Air conditioning requirements: requirement for comfort cooling or close control

Air conditioning strategies: types of air conditioning plant

Cooling loads:

Estimation of heat gains and cooling loads

Factors affecting the cooling load requirements, building/room use, shading, building construction and orientation, internal heat gains

Psychrometrics:

Psychrometric principles: psychrometric terms and properties

Plotting psychrometric processes using charts

Use of psychrometric charts to determine cooling coil, heater battery, frost coil and humidifier duties

LO3 **Investigate the operational characteristics of non-domestic heating systems**

Heating systems:

Heating requirements: approved documents, occupant's comfort

Heat loss calculations: heat losses though a structure, U values and there use in calculating heating load requirements

Heating strategies: local or centralised systems

Heating system components and typical system layouts

Fuels:

Properties and characteristics of common solid, liquid and gaseous fuels

Combustion:

Combustion principles

Products of complete and incomplete combustion and their implications

Minimum air requirements for stoichiometric combustion

Causes of incomplete combustion

Boiler efficiency:

Boiler efficiency calculations

LO4 **Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems**

Requirement of the BMS:

Client/end user requirements and operational needs, energy efficiency concerns

Function of a BMS:

Systems controlled by BMS: heating, lighting, ventilation, air conditioning, security/access

Energy monitoring and reporting

BMS hardware:

Types of BMS hardware available, advantages and disadvantages, performance and cost. Controlling software, remote access and control

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Explain the operating principles of non-domestic ventilation systems</td><td rowspan="5">LO1 & LO2

D1 Evaluate and compare a number of passive and active methods used to help cool buildings giving suitable examples</td></tr>
<tr><td>P1 Explain and compare two alternative ventilation strategies for a non-domestic building and recommend the most suitable

P2 Using the information from P1, calculate the ventilation requirements for the rooms in a non-domestic building</td><td>M1 Discuss the types of fans used in non-domestic ventilation systems and analyse their characteristics</td></tr>
<tr><td colspan="2">LO2 Explore the range of air conditioning systems</td></tr>
<tr><td>P3 Explain the requirement for air conditioning in a variety of non-domestic buildings

P4 Estimate the cooling load requirements for rooms in non-domestic buildings using a recognised ‘rule of thumb’ method</td><td>M2 Analyse the factors affecting the cooling loads in buildings</td></tr>
</table>

Pass	Merit	Distinction
LO3 Investigate the operational characteristics of non-domestic heating systems		**LO3 & LO4** **D2** Calculate the minimum air requirements for a given fuel and distinguish between complete and incomplete combustion, predicting the possible consequences of incomplete combustion
P5 Explain and compare two alternative heating strategies for a non-domestic building and recommend the most suitable **P6** Estimate the heating load requirements for rooms in non-domestic buildings using a recognised 'rule of thumb' method	**M3** Discuss the combustion properties of common fuels used in non-domestic heating systems	
LO4 Describe the role Building Management Systems (BMS) have in controlling and monitoring HVAC systems		
P7 Describe the requirements of a building management system in non-domestic buildings **P8** Describe the functions performed by a building management system in a non-domestic building	**M4** Evaluate the advantages of a building fitted with a full Building Management System	

Recommended Resources

Textbooks

CHADDERTON, D. (2013) *Building Services Engineering*. 6th Ed. Abingdon: Routledge.

CIBSE. (2009) *CIBSE Guide H: Building control systems*. CIBSE, London.

HALL, F. and GREENO, R. (2009) *Building Services Handbook.* 5th Ed. Oxford: Elsevier.