Unit 66: Building Services Science

Unit code: T/600/0297

QCF Level: 3

Credit value: 10

Guided learning hours: 60

Unit aim

The aim of this unit is to provide an understanding of heat transfer, thermodynamics, electricity, combustion and psychrometry for the building services industry.

Learning outcomes and assessment 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 determine the standard required to achieve the unit.

Learning outcomes	Assessment criteria
1 Understand the nature of energy in solids, liquids and gases, and the fundamental principles of heat transfer in building services applications	1.1 Explain the fundamental principles of energy conversion and heat transfer as applied to building services engineering applications
2 Understand the principles of electricity and combustion as they apply to the provision of electrical power, natural gas and other fossil fuel energy systems	2.1 Discuss the essential characteristics of natural gas and other fossil fuel energy systems in terms of the principles of combustion
	2.2 Discuss the essential characteristics of electrical energy systems in terms of the principles of electricity
3 Understand the thermodynamic properties of solids, liquids and gases as they apply to changes of state in heating, air conditioning and refrigeration installations	3.1 Analyse sensible enthalpy, latent enthalpy and changes of state within building services engineering applications
	3.2 Analyse the factors that determine pressure, saturation temperature and enthalpy for water and refrigerant gases

4 Understand the principles of psychrometry as they apply to air conditioning systems	4.1 Explain the psychrometric properties of air and water vapour mixtures

Unit content

1 Understand the nature of energy in solids, liquids and gases, and the fundamental principles of heat transfer in building services applications

Nature of energy: different forms of energy; units of energy; principle of the conservation of energy; absolute temperature scale; Kelvin and Celsius; specific heat capacity

Principles of heat transfer: types of heat transfer; applications and significance in building services systems; conduction transfer through single slab and composite structures; convection transfer due to free/natural convection in air from vertical and horizontal panels and horizontal cylindrical objects; radiation heat transfer from plane surfaces

2 Understand the principles of electricity and combustion as they apply to the provision of electrical power, natural gas and other fossil fuel energy systems

Electricity: electromagnetic induction; principles of alternating current (AC) generation; AC quantities; power in AC circuits; transformer principles; force on a current carrying conductor and its applications

Combustion of fuels: properties and characteristics of common solid, liquid and gaseous fuels; products of complete and partial combustion and their implications; minimum air requirements for stoichiometric combustion; requirements for excess air; need for control of excess air quantities; causes of incomplete combustion

3 Understand the thermodynamic properties of solids, liquids and gases as they apply to changes of state in heating, air conditioning and refrigeration installations

Thermodynamic properties and processes: relationship between pressure, saturation temperature and enthalpy; thermodynamic properties for water and refrigerants; use of tables and pH diagrams to solve problems; plotting processes and refrigeration cycles

Ideal gases: relationship between pressure, temperature, volume and mass; application of general gas law and characteristic gas equation; Dalton's law

Change of state: kinetic theory of matter; reasons for change of state; sensible and latent heat; enthalpy change, problems incorporating latent heat of fusion and latent heat of vaporisation at constant pressure; examples within building services engineering where change of state occurs and latent heat is encountered

4 Understand the principles of psychrometry as they apply to air conditioning systems

Psychrometric principles: psychrometric terms and properties; psychrometric properties of air and water vapour mixtures by calculation, measurement, tables and charts

Air conditioning systems: air conditioning processes and cycles; psychrometric process lines for sensible heating and cooling, dehumidification and humidification (using different types of humidifiers); resulting condition from mixture of two air streams; plotting summer and winter psychrometric cycles for given arrangements of air conditioning plant and operating conditions; plant duties from psychrometric chart