

## Liverpool John Moores University

Title: MECHANICAL SERVICES INSTALLATIONS  
Status: Definitive  
Code: **4504BEFDS** (118440)  
Version Start Date: 01-08-2011

Owning School/Faculty: Built Environment  
Teaching School/Faculty: Built Environment

Team	Leader
Derek King	

**Academic Level:** FHEQ4      **Credit Value:** 36.00      **Total Delivered Hours:** 159.00  
**Total Learning Hours:** 360      **Private Study:** 201

### Delivery Options

Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	96.000
Tutorial	36.000
Workshop	24.000

**Grading Basis:** 40 %

### Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	ICA	In class assessment	25.0	3.00
Exam	Exam	Formal examination	25.0	3.00
Artefacts	Project	Design project	50.0	

### Aims

*The aim of this module is to develop the students' understanding of the main principles and practices for the design, operation and commissioning of mechanical building services systems in medium sized public sector, commercial or industrial buildings. Among the services included are heating, ventilation, air conditioning, hot and cold water, public health, fire engineering, fuel and specialist gas installations, and these are approached with a view to sustainability of design and future*

operation.

## Learning Outcomes

After completing the module the student should be able to:

- 1 Analyse buildings and identify the needs and priorities for heating, ventilation, air conditioning, water supplies, gas distribution, fire fighting and fire protection.
- 2 Determine heating and cooling loads required to maintain design temperatures in buildings and the potential peak summertime temperatures for spaces without air conditioning.
- 3 Produce and evaluate detailed heating, ventilation and air conditioning system designs to satisfy the needs of complex buildings.
- 4 Produce and evaluate detailed designs for cold and hot water supply systems for complex buildings.
- 5 Produce and evaluate detailed designs for fire fighting and fire suppression/protection installations.
- 6 Produce and evaluate detailed designs for fuel gas, industrial & medical gas and compressed air installations.
- 7 Select and specify appropriate heating plant, energy sources and their associated equipment for space heating and hot water generation systems and detail their installation and operational requirements.
- 8 Select and specify appropriate cooling plant and associated equipment for air conditioning systems and detail their installation and operational requirements.
- 9 Produce data and documentation necessary to facilitate the commissioning of heating, ventilation, air conditioning, water supplies, gas distribution, fire fighting and fire protection installations.

## Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

In class assessment	1	9				
Exam	2	8				
Design project	3	4	5	6	7	

## Outline Syllabus

*Specification and requirements for heating, ventilation and air conditioning: analysis of client and building needs, heating, ventilation and air conditioning design standards and publications. Identifying targets for sustainability and energy efficiency. Overview of mechanisms for assessing the compliance with statutory and non-statutory environmental compliance. Influence of sustainability standards and targets on design solutions*

*Designing for health and safety, risk assessment to identify potential risks.*

*Thermal comfort: Selecting design conditions for thermal comfort effect of radiation on comfort.*

*Steady and non-steady state heat transfer in buildings: concept of steady state*

energy transfer networks. Steady state heating loads. Effect of intermittent and highly intermittent heating on heat loads, pre-heat periods. Application of diversity, use of margins, rules of thumb, strategies for reducing heat loads, levels of air tightness in buildings, methods of testing air tightness, assessing infiltration rates in buildings.

Cooling loads due to solar radiation: transmission of solar radiation through glass and building structures. Strategies for reducing cooling loads. Cooling loads due to solar gain. Determining casual and internal gains, use of profiles with casual gains. Impact of alternative design temperature.

Total cooling load and cooling plant capacity: Peak summertime temperatures anticipated in the absence of air conditioning. Use of thermal analysis software to determine heating and cooling loads.

Heat emitters: selection criteria for radiant, convection and mixed output emitters, direct fired emitters, design requirements, design stanars for under-floor heating, and heated ceilings.

Design of heating systems: for non-domestic buildings. Layout, specification and control systems, integration of heating requirements with other services installations. Evaluation of proposed systems.

Primary Heat Sources and hot water generators: types of commercial LPHW boiler, primary heat sources and hot water generation plant, use of ground and air source heat pumps as primary heat sources. Configuration and control of single and multiple boiler installations, boiler and heat pump combinations. Fuel consumption and operational efficiency. Alternative methods of heating buildings.

Fuels: properties, characteristics, performance, and environmental implications, renewable fuels, storage and feed requirements.

Combustion principles: stoichiometric air fuel ratios, excess air

Products of combustion: flue gas analysis, air fuel ratios and combustion efficiency.

Firing equipment: Control and safety monitoring systems. Air/Fuel adjustment and burner commissioning.

Boiler-room ventilation, draught and flue requirements: legislation and standards of flue systems for single and multiple boiler installations. Legislation and standards design and installation of flue systems for single and multiple boiler installations.

Specification and requirements: Factors influencing the decision to install mechanical air conditioning or ventilation systems. Alternative methods of cooling buildings.

Ventilation systems: natural and mechanical ventilation systems for commercial and industrial buildings.

Design of natural ventilation systems, prediction and calculation of natural ventilation/infiltration rates, effect of window design, manual and automatic operation of natural ventilation, risk and implications of use of natural ventilation. Air leakage testing. Passive cooling systems. Mixed mode and displacement ventilation systems. Fume and dust extraction systems. Combination of ventilation with commercial air conditioning systems.

Air conditioning systems: Single duct, terminal re-heat, VAV, fan-coil, Control systems for the various systems. Design, sizing and selection of plant, ductwork and pipework, Implications on space, maintenance and commissioning requirements, capital and operating costs. Use of heat recovery techniques within ventilation and air conditioning systems. Centralised v packaged equipment,

Commissioning and testing requirements: Commissioning schedules and documentation.

*Needs analysis and legislative requirements for public health engineering systems: client and building operational requirements, legislative constraints, statutory requirements, design standards and relevant publications. Health, safety and welfare arrangements, energy efficiency considerations. Compliance requirements, methods of achievement and benchmark targets.*

*Cold & Hot Water Installations: Design and specification of cold and hot water storage and distribution systems for complex and multi-storey commercial buildings. Control systems and valve arrangements. Booster and pumping systems, pressure reduction and control. Integration of rainwater harvesting, grey water recycling and solar thermal hot water within standard hot and cold water installations. Application of legislation, standards and guides for the design, maintenance and commissioning of hot and cold water installations.*

*Hot & Cold Water Plant: sizing, selection and specification of hot and cold water pipework, plant and equipment for; cold water installations, hot water storage, semi storage and non-storage installations, rainwater harvesting, grey-water recycling and solar thermal hot water installations. Space requirements for storage plant. Use of manufacturers data, sizing and selection software.*

*Water systems commissioning maintenance and treatment: water analysis, water treatment for hot and cold water installations. Commissioning and testing of cold and hot water storage and distribution systems. Specific health & safety design and maintenance requirements and compliance standards for control of Legionella and pathogenic bacteria growth.*

*Mechanical fire fighting and fire protection systems:*

*Fire dynamics: ignition, fire growth, fire parameters, flash over, limiting fire development,*

*smoke hazards, smoke plumes, smoke filling*

*Legislation and standards: for fire engineering analysis, current legislation documents,*

*standards and codes of practice, design implications, fire safety strategy.*

*Fire compartments & Means of escape: behaviour of people, occupancy types, travel distances and times, requirement of compartments,*

*Fire risk: risk assessment, building designation factors and classification, fire precaution standards.*

*Mechanical fire engineering systems: design of mechanical fire fighting systems and other mechanical fire protection systems for various commercial buildings containing. Sizing and selection of pipework, plant and equipment for fire fighting installation.*

*Testing and maintenance procedures*

*Fuel gas, industrial gases, medical gas and compressed air installations*

*Properties and application: range, properties and usage of fuel gases, industrial and medical gases, vacuum and compressed air*

*Legislation and standards: current legislation documents, standards and codes of practice, design and safety implications*

*Installation design: design of fuel gas, industrial and medical gas, vacuum and compressed air installations for industrial and commercial buildings. Sizing and selection of materials, plant and equipment, and components use of manufacturers. data, sizing and selection software*

*Testing and commissioning: procedures for the testing, commissioning and purging of systems.*

## Learning Activities

Lectures, tutorials, case studies, workshops, site visits.

## References

<b>Course Material</b>	Book
<b>Author</b>	Chadderton. D.
<b>Publishing Year</b>	2007
<b>Title</b>	Building Services Engineering
<b>Subtitle</b>	
<b>Edition</b>	5th
<b>Publisher</b>	Spon Press
<b>ISBN</b>	978-0-415-41355-8

<b>Course Material</b>	Book
<b>Author</b>	Moss. K.
<b>Publishing Year</b>	2007
<b>Title</b>	Heat and Mass Transfer in Buildings
<b>Subtitle</b>	
<b>Edition</b>	2nd
<b>Publisher</b>	Spon Press
<b>ISBN</b>	978-0-415-40908-7

<b>Course Material</b>	Book
<b>Author</b>	Chadderton, D.
<b>Publishing Year</b>	1997
<b>Title</b>	Air Conditioning
<b>Subtitle</b>	A Practical Introduction
<b>Edition</b>	2nd
<b>Publisher</b>	Spon Press
<b>ISBN</b>	0419226109

<b>Course Material</b>	Book
<b>Author</b>	Jones, W.P.
<b>Publishing Year</b>	2001
<b>Title</b>	Air Conditioning Engineering
<b>Subtitle</b>	
<b>Edition</b>	5th
<b>Publisher</b>	Butterworth-Heinemann
<b>ISBN</b>	0750650745

<b>Course Material</b>	Book
<b>Author</b>	Moss. K.
<b>Publishing Year</b>	2003

<b>Title</b>	Heating and Water Services Design in Buildings
<b>Subtitle</b>	
<b>Edition</b>	2nd
<b>Publisher</b>	Spon Press
<b>ISBN</b>	0-415-29185-2

<b>Course Material</b>	Book
<b>Author</b>	British Standards Institute
<b>Publishing Year</b>	2000
<b>Title</b>	Hot and Cold Water Supply
<b>Subtitle</b>	
<b>Edition</b>	
<b>Publisher</b>	Blackwell Science
<b>ISBN</b>	0632049855

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2006
<b>Title</b>	Guide A
<b>Subtitle</b>	Environmental Design
<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287669

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2001
<b>Title</b>	Guide B2
<b>Subtitle</b>	Ventilation & Air Conditioning
<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287162

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2005
<b>Title</b>	Guide B3
<b>Subtitle</b>	Ductwork
<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287200

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2003
<b>Title</b>	Guide E
<b>Subtitle</b>	Fire Engineering

<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287316

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2004
<b>Title</b>	Guide F
<b>Subtitle</b>	Energy Efficiency in Buildings
<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287340

<b>Course Material</b>	Book
<b>Author</b>	Chartered Institution of Building Services Engineers
<b>Publishing Year</b>	2004
<b>Title</b>	Guide G
<b>Subtitle</b>	Public Health Engineering
<b>Edition</b>	
<b>Publisher</b>	CIBSE, London
<b>ISBN</b>	1903287421

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## Notes

This module is a key component for those students wishing to complete the programme following a 'mechanical' building services pathway. It provides those students who have a basic awareness of the principles and processes of heating, ventilation and air conditioning with a detailed understanding of the mechanisms involved in the thermal response of building and the ability to design and specify commercially viable systems. It also develops a detailed understanding of the principles and procedures associated with energy efficient, sustainable hot and cold water installations and fire engineering and provides an overview of the requirements for fuel, industrial and medical gas systems within commercial buildings.