Liverpool John Moores University

Title:	THERMOFLUIDS
Status:	Definitive
Code:	**5087UG** (102659)
Version Start Date:	01-08-2011
Owning School/Faculty:	Built Environment
Teaching School/Faculty:	Built Environment

Team	Leader
Derek King	Y

Academic Level:	FHEQ5	**Credit Value:**	12.00	**Total Delivered Hours:**	38.00
Total Learning Hours:	120	**Private Study:**	82		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	24.000
Tutorial	12.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	AS1	Formal.	70.0	2.00
Test	AS2	Lab work.	20.0	
Report	AS3	Assignment.	10.0	

Aims

To further develop the student's understanding and analysis of the principles and applications of fluid flow, heat transfer and thermodynamic cycles in the design and specification of mechanical building services installations.

Learning Outcomes

After completing the module the student should be able to:

1 Analyse modes of heat and vapour transfer and apply the principles to building services engineering.
2 Investigate the performance of heat exchangers commonly found with building services plant and installations.
3 Investigate thermodynamic cycles and how these relate to refrigeration plant and components.
4 Apply dimensional analysis to fundamental and empirical formulae.

Learning Outcomes of Assessments

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

EXAM	1	3	4
TEST	1	2	3
REPORT	4		

Outline Syllabus

Convection: use of bulk, arithmetic mean temperature difference (AMTD) and log mean temperature difference (LMTD) in free and forced convection processes. Grashoff, Nusselt, Reynolds, Prandtl dimensionless groups. Heat transfer coefficients and heat flux.
Radiation: Reflectivity, transmissivity, absorptivity, emissivity for different surfaces. Wave characteristics and parameters associated with electromagnetic radiation. Variation of black body emissive power. Use of form factors to determine radiant heat exchange. Applications of radiant heat transfer in building services. Plane radiant temperature, vector radiant temperature, discomfort due to asymmetric radiation. Causes of discomfort asymmetry.
Vapour transfer: principles of vapour transfer. Moisture transfer through composite structures. Problems associated with condensation and its prevention. Vapour mass transfer within building services applications.
Heat exchangers: Identification of modes of heat transfer within building services equipment and applications. heat exchanger construction, characteristics, fluid flow paths, pressure drop, design, types and classification. (e.g. Shell and Tube, Shell and Coil, Tube in Tube and Plate etc). Thermal transmittance through the heat exchanger boundary wall, solid boundary and boundary layers.
Resistances and factors, effectiveness and loss of performance. Rate of heat exchange in parallel flow and counterflow. Performance using Effectiveness, Capacity Ratio, Number of Transfer Units (NTU) and LMTD for parallel flow and counterflow. Cross flow heat exchangers. Performance of heat exchangers for evaporating and condensing fluids in single and two-phase fluid condition.
Thermodynamic cycles: Use of T-S and p-H diagrams to construct heating and cooling refrigeration cycles. Thermodynamic processes in refrigeration cycles, heat pumps and heat engines. Comparison between practical refrigeration/heat pump cycle and the Carnot Cycle. Performance analysis of refrigeration/heat pumps in cooling and heating modes. Mass flow rates, input power, capacity, efficiencies,

temperature and COP for theoretical and actual cycle arrangements. Dimensional analysis: units and dimensions in commonly used terms and parameters, Checking rational formulae. Identify dimensionless groups in rational and empirical formulae e.g. Reynolds Number, Grashof Number, Nusselt Number and Prandtl Number etc.
Application of dimensional analysis: Derivation of appropriate rational and empirical building services formulae from known variables. Application of dimensional analysis to solve appropriate problems related to building services applications.

Learning Activities

Lectures, tutorials, lab-work practical, case studies.

References

Course Material	Book
Author	Moss, K.
Publishing Year	1998
Title	Heat and Mass Transfer in Building Services Design
Subtitle	
Edition	
Publisher	Spon Press
ISBN	0419226508

Course Material	Book
Author	Moss, K.
Publishing Year	2003
Title	Heating and Water Services Design in Buildings
Subtitle	
Edition	2nd Edition
Publisher	Spon Press
ISBN	0415291852

Course Material	Book
Author	Beggs, C.
Publishing Year	2002
Title	Energy :Management, Supply and Conservation
Subtitle	
Edition	
Publisher	Butterworth-Heinemann
ISBN	0750650966

Course Material	Book
Author	Cengel, A.Y. & Boles, M.A.
Publishing Year	2002

Title	Thermodynamics
Subtitle	An Engineering Approach
Edition	4th Edition
Publisher	McGraw-Hill Education
ISBN	0071150714

Notes

This module provides the essential underpinning knowledge of the processes and principles that lie at the core of much of the plant and processes that are used within the mechanical building services systems. This underpinning knowledge is valid in its own right for students following this discipline but also supports and makes sense of the modules of space heating, water services, ventilation and air conditioning etc.