Liverpool John Moores University

Title:	MATHEMATICS & SCIENCE FOR BUILDING SERVICES APPLICATIONS
Status:	Definitive
Code:	**4500BEFDS** (118436)
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:**	24.00	**Total Delivered Hours:**	121.00
Total Learning Hours:	240	**Private Study:**	119		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	84.000
Practical	10.000
Tutorial	24.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	Exam	Formal examination	60.0	3.00
Report	Report	Report based on practical activities	40.0	

Aims

To provide the students with an understanding of the fundamental principles and concepts used in a wide range building services applications and the range of mathematical techniques needed to solve related problems. The module aims to provide a fundamental understanding of both the mathematical techniques and scientific principles essential to allow the various Building Services specialists to integrate and communicate effectively and a basis from which the more specialised

services applications can be developed. The module explores core fundamental principles of thermal comfort, fluid flow, heat transfer, sound & acoustics and alternating electrical quantities.

The knowledge and skills acquired in this module underpin most other modules in the Building Services Engineering HNC and FD programmes.

Learning Outcomes

After completing the module the student should be able to:

1 Use the laws of indices and logarithms in the solution of building services engineering problems.
2 Apply complex numbers, using 'j' notation in the solution of building services applications.
3 Apply the techniques of differentiation and integration to the solution of building services engineering problems.
4 Use mathematical and computer techniques to compare statistical data and solutions obtained from building services and construction problems.
5 Apply deterministic and adaptive models of thermal comfort and the basic principles of heat transfer in the design of building services thermal systems.
6 Apply the basic principles of fluid mechanics to solve problems in the flow of fluids in pipe and duct networks.
7 Apply the basic principles of resonant and non-resonant single phase electrical circuits to the design of electrical services systems.
8 Apply the basic principles of light and lighting to the design of the visual environment.
9 Apply the basic principles of sound, vibration and acoustics to the design of the aural environment.

Learning Outcomes of Assessments

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

Exam	1	2	3	4	7
Practical based report	5	6	8	9	

Outline Syllabus

Laws of Indices and Logarithms: laws of indices, exponential functions, logarithms, indical equations.
Complex Numbers: vector representation, cartesian and polar Forms, 'j' notation, adding, subtracting, multiplying and dividing complex numbers
Differential calculus: basic principles, gradients of straight lines and curves, differentiating algebraic, trigonometrical, exponential and logarithmic expressions, the second derivative, velocity and acceleration, maxima & minima, method of least squares.
Integral calculus: basic principles defining integration, integrating algebraic and trigonometrical functions, the definite integral, calculating areas under graph curves,

numerical integration.
Statistics: Application statistics to construction problems, tables & graphs, data collection & presentation, central tendency, dispersion.

Thermal comfort in humans: factors affecting humans, types and application of thermal indices. Methods of predicting thermal comfort and the reliability of design criteria.
Heat transfer rates: basic principles of heat transfer by conduction, radiation and convection. Measurement of the thermal comfort environment. Natural and forced convection. Rates of radiant heat transfer for black and grey body radiation. Thermal and permeability properties of materials. Conduction transfer through homogeneous and multi-layered and thermally bridged structures. Heat conduction rates using star and delta thermal resistance networks. Heat transfer through insulated surfaces, economic insulation thickness. Effect of Humidity in the internal environment. Temperature gradients and interstitial condensation risk in structures.
Fluid flow: principles of uniform, steady, and continuity of flow.
Energy in flowing fluids: Conservation of energy in a moving fluid, Bernoulli's equation. Measurement using venturi, orifice plate and pitot-static tubes.
Reynolds number: laminar and turbulent fluid flow, boundary separation and transition.
Energy losses in flowing fluids: principles and applications of frictional losses in pipe and duct networks including fittings. Principles of static regain in ductwork systems.
Electrical networks: non-resonant single phase ac circuits, quantities in series, parallel and combined R.L.C networks. Power factor, true, reactive and apparent power. Heating and magnetic effects.
Resonant ac circuits: circuit resonance, circuit conditions at resonance for various arrangements of induction coil and capacitor, resonant frequency and dynamic frequency. Power factor correction: capacitance required to improve the overall power factor, reasons for power factor correction.
Fundamentals of light: terminology and units of light, inverse square law, cosine law, colour temperature
Visual effects of lighting: lighting levels, glare, illumination for task performance, appearance, colour rendering, revealing form, measurement of light and the visual environment.
Sound: decibel scales, measurement of sound, equivalent continuous noise levels, sound power level (SPL), sound intensity level (SIL). Sound power/frequency spectra. Propagation of acoustic energy, sound insulation and attenuation.
Noise control: attenuation characteristics of materials, components and systems associated with building services. Acoustic enclosures. Noise control solutions for building services plant and applications.
Room acoustics: room characteristics, background and total sound levels, and reverberation time
Noise criteria and effect: noise rating/criteria curves and their application in acoustic design. Privacy criteria. Speech intelligibility. Evaluation of sound and vibration effects. Design criteria in building services.
Vibration: simple harmonic motion, modes of vibration, characteristics of springs, static and dynamic modulus of materials and natural frequency. Vibration isolation.

Learning Activities

Lectures, tutorials & laboratory practical sessions.

References

Course Material	Book
Author	Greer, A. & Taylor, G.
Publishing Year	2004
Title	Mathematics for Technicians
Subtitle	
Edition	
Publisher	Nelson & Thorns
ISBN	928-0-7487-7949-9

Course Material	Book
Author	Bird, J
Publishing Year	2009
Title	Basic Engineering Mathematics
Subtitle	
Edition	5th
Publisher	Newnes
ISBN	0-7506-6575-0

Course Material	Book
Author	Croft, A. & Davidson, R.
Publishing Year	2004
Title	Mathematics For Engineers
Subtitle	
Edition	
Publisher	Pearson
ISBN	0-131-20193-X

Course Material	Book
Author	Stroud, K.A.
Publishing Year	2007
Title	Engineering Mathematics
Subtitle	
Edition	6th
Publisher	Palgrave Macmillan
ISBN	1-4039-4246-3

Course Material	British Standards
Author	British Standards Institute
Publishing Year	2006
Title	BS ISO 7730:2005

Subtitle	Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria
Edition	
Publisher	BSI, London
ISBN	

Course Material	Reports
Author	Chartered Institute of Building Services Engineers
Publishing Year	2006
Title	TM40
Subtitle	Health issues in building services
Edition	
Publisher	CIBSE, London
ISBN	9781903287651

Course Material	Reports
Author	Chartered Institute of Building Services Engineers
Publishing Year	2006
Title	KS6
Subtitle	Comfort
Edition	
Publisher	CIBSE, London
ISBN	9781903287675

Course Material	Book
Author	Chartered Institute of Building Services Engineers
Publishing Year	2007
Title	Guide A
Subtitle	Environmental Design
Edition	
Publisher	CIBSE, London
ISBN	9781903287668

Course Material	British Standards
Author	British Standards Institute
Publishing Year	1998
Title	BS EN ISO12241:1998
Subtitle	Thermal insulation for building equipment and industrial installations — Calculation Rules
Edition	
Publisher	BSI, London
ISBN	

Course Material	Book
Author	Lewis, M.L

Publishing Year	1990
Title	Electrical Installation Technology 2
Subtitle	Science and Calculations
Edition	3rd
Publisher	Stanley Thornes (Publishers) Ltd, Cheltenham
ISBN	

Course Material	Book
Author	Morris, N.M.
Publishing Year	1994
Title	Electrical & Electronic Engineering Principles
Subtitle	
Edition	
Publisher	Pearson Education Ltd, Harlow
ISBN	

Course Material	Book
Author	Moss, K.
Publishing Year	2007
Title	Heat and Mass Transfer in Building Services Design
Subtitle	
Edition	
Publisher	Taylor & Francis Ltd.
ISBN	9780415409087

Course Material	Book
Author	Beggs, C.
Publishing Year	2002
Title	Energy
Subtitle	Supply and Conservation
Edition	
Publisher	Butterworth-Heinemann
ISBN	0-7506-5096-6

Course Material	Book
Author	Smith, B.J. Peters, R.J. Owen,S.
Publishing Year	1996
Title	Acoustics and Noise Control
Subtitle	
Edition	
Publisher	Longman
ISBN	0-582-08804-6

Notes

This module provides fundamental understanding of key mathematical and scientific

concepts and the application of these to solve building services engineering problems.