**Liverpool** John Moores University

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| Title: | SCIENCE FOR BUILDING SERVICES APPLICATIONS |
| Status: | Definitive |
| Code: | **4602BEFDL** (123835) |
| Version Start Date: | 01-08-2016 |
| Owning School/Faculty: | Built Environment |
| Teaching School/Faculty: | City of Liverpool College |

| Team | Leader |
|---|---|
| Alfred Leung | Y |

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| **Academic Level:** | FHEQ4 | **Credit Value:** | 20 | **Total Delivered Hours:** | 75 |
| **Total Learning Hours:** | 200 | **Private Study:** | 125 | | |

**Delivery Options**
Course typically offered: Non Standard Year Long

| Component | Contact Hours |
|---|---|
| Lecture | 60 |
| Practical | 6 |
| Tutorial | 6 |

**Grading Basis:** 40 %

**Assessment Details**

| Category | Short Description | Description | Weighting (%) | Exam Duration |
|---|---|---|---|---|
| Exam | AS1 | FORMAL EXAMINATION | 50 | 3 |
| Report | AS2 | TECHNICAL REPORT | 50 | |

**Aims**

*To provide the learner with the opportunity to acquire knowledge of a range of mathematical techniques and will develop his/her understanding of how these techniques can be applied to the solution of problems encountered in Building Services Engineering.*

*The knowledge and skills which the learner acquires in this unit will underpin his/her*

*study of most other modules in the programme.*

## Learning Outcomes

After completing the module the student should be able to:

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| 1 | Identify factors influencing human thermal comfort. |
| 2 | Apply basic principles to solve problems in the transfer of heat energy |
| 3 | Apply basic principles to solve problems in the flow of fluids in pipe and duct networks. |
| 4 | Investigate simple single phase resonate & non-resonate ac electrical networks. |
| 5 | Apply the basic principles of light and lighting to the design of the visual environment. |
| 6 | Investigate the basic principles of sound, vibration and room acoustics. |
| 7 | Apply the basic principles of control theory to the building services engineering. |

## Learning Outcomes of Assessments

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

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|---|---|---|---|---|
| FORMAL EXAMINATION | 2 | 4 | 6 | |
| TECHNICAL REPORT | 1 | 3 | 5 | 7 |

## Outline Syllabus

*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. Natural and forced convection. Rates of radiant heat transfer for black and grey body radiation. Conduction transfer through homogeneous and multi-layered and thermally bridged structures. Heat transfer through insulated surfaces, economic insulation thickness. 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. Principles measurement using venturi, orifice plate and pitot-static tubes. Reynolds number: laminar and turbulent fluid flow, boundary separation and transition.*

*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.*

*Resonant A.C. circuits: circuit resonance, circuit conditions at resonance for various arrangements of induction coil and capacitor.*
*Power factor correction: capacitance required to improve the overall power factor,*

*reasons for power factor correction.*

*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.*

*Control Concepts: load, lag and deviation*
*Elements and systems: sensing elements; controllers; actuators; analogue and digital control; control modes (on-off, step, floating, proportional, integral and derviative); overview Building Management energy system.*

**Learning Activities**

Lectures, tutorials, laboratory practical sessions

**Notes**

Building design is increasingly geared towards providing a high quality environment with low energy consumption. Understanding the fundamentals of thermal comfort, heat transfer, the behaviour of air and water movements, the principles of electrical circuits, sound and acoustics is more important than ever before. This module provides the essential underpinning knowledge of these subjects that lie at the very core of building services engineering. This underpinning knowledge is valid in its own right for both technical and non-technical professions but can be further developed within the modules of space heating, water services, ventilation and air conditioning, electrical installations, etc.