Unit 8: Mathematics for Construction

Unit code	**K/615/1394**
Unit level	**4**
Credit value	**15**

Introduction

The aim of this unit is to develop students' skills in the mathematical principles and theories that underpin the civil engineering and building services curriculum. Students will be introduced to mathematical methods and statistical techniques in order to analyse and solve problems within a construction engineering context.

Topics included in this unit are: dimensional analysis, arithmetic and geometric progressions wave and vector functions, differential and integral calculus, binomial and normal distribution, sinusoidal waves, and trigonometric and hyperbolic identities, among other topics.

On successful completion of this unit students will be able to employ mathematical methods within a variety of contextualised examples, interpret data using statistical techniques, and use analytical and computational methods to evaluate and solve engineering construction problems. Therefore, they will also gain crucial employability skills such as critical thinking, problem solving, analysis, reasoning, and data interpretation.

Learning Outcomes

By the end of this unit students will be able to:

1. Identify the relevance of mathematical methods to a variety of conceptualised construction examples.
2. Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages.
3. Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective construction applications.
4. Illustrate the wide-ranging uses of calculus within different construction disciplines by solving problems of differential and integral calculus.

Essential Content

LO1 **Identify the relevance of mathematical methods to a variety of conceptualised construction examples**

Mathematical concepts.

Dimensional analysis.

Arithmetic and geometric progressions.

Functions.

Exponential, logarithmic, circular and hyperbolic functions.

LO2 **Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages**

Summary of data.

Mean and standard deviation of grouped data.

Pearson's correlation coefficient.

Linear regression.

Probability theory.

Binomial and normal distribution.

Hypothesis testing for significance.

LO3 **Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective construction applications**

Sinusoidal waves.

Sine waves and applications.

Trigonometric and hyperbolic identities.

Vector functions.

Vector notation and properties.

Representing quantities in vector form.

Vectors in three dimensions.

LO4 **Illustrate the wide-ranging uses of calculus within different construction disciplines by solving problems of differential and integral calculus**

Differential calculus.

Differentiation of functions.

Stationary points.

Rates of change.

Integral calculus.

Definite and indefinite integration.

Integrating to determine area and common functions.

Integration by substitution.

Exponential growth and decay.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Identify the relevance of mathematical methods to a variety of conceptualised construction examples</td><td rowspan="5">LO1 LO2
D1 Present statistical data in a method that can be understood by a non-technical audience.</td></tr>
<tr><td>P1 Apply dimensional analysis techniques to solve complex problems.
P2 Generate answers from contextualised arithmetic and geometric progressions.
P3 Determine the solutions of equations using exponential, trigonometric and hyperbolic functions.</td><td>M1 Apply dimensional analysis to derive equations.</td></tr>
<tr><td colspan="2">LO2 Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages</td></tr>
<tr><td>P4 Summarise data by calculating mean and standard deviation, and simplify data into graphical form.
P5 Calculate probabilities within both binomially distributed and normally distributed random variables.</td><td>M2 Interpret the results of a statistical hypothesis test conducted from a given scenario.</td></tr>
<tr><td colspan="2">LO3 Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective construction applications</td><td rowspan="2">D2 Model the combination of sine waves graphically and analyse the variation between graphical and analytical methods.</td></tr>
<tr><td>P6 Solve construction problems relating to sinusoidal functions.
P7 Represent construction quantities in vector form, and apply appropriate methodology to determine construction parameters.</td><td>M3 Apply compound angle identities to separate waves into distinct component waves.</td></tr>
</table>

Pass	Merit	Distinction
LO4 Illustrate the wide-ranging uses of calculus within different construction disciplines by solving problems of differential and integral calculus		
P8 Determine rates of change for algebraic, logarithmic and circular functions. **P9** Use integral calculus to solve practical problems relating to engineering.	**M4** Formulate predictions of exponential growth and decay models using integration methods.	**D3** Analyse maxima and minima of increasing and decreasing functions using higher order derivatives.

Recommended Resources

Textbooks

SINGH, K. (2011) *Engineering Mathematics Through Applications*. 2nd Ed. Basingstoke: Palgrave Macmillan.

STROUD, K. A. and BOOTH, D.J. (2013) *Engineering Mathematics*. 7th Ed. Basingstoke: Palgrave Macmillan.

Websites

mathcentre.ac.uk	Mathcentre (Training/Tutorials)
mathtutor.ac.uk	Mathtutor (Training/Tutorials)

Links

This unit links to the following related units:

Unit 9: Principles of Heating Services Design & Installation

Unit 10: Principles of Ventilation and Air Conditioning Design & Installation

Unit 17: Principles of Public Health Engineering

Unit 18: Civil Engineering Technology

Unit 19: Principles of Electrical Design & Installation

Unit 28: Further Mathematics for Construction

Unit 30: Advanced Structural Design

Unit 31: Advanced Heating, Ventilation and Air Conditioning Design & Installation

Unit 33: Advanced Electrical Design & Installation

Unit 43: Hydraulics

