

## Unit 2:

## Engineering Maths

<b>Unit code</b>	<b>M/615/1476</b>
<b>Unit type</b>	<b>Core</b>
<b>Unit level</b>	<b>4</b>
<b>Credit value</b>	<b>15</b>

---

### Introduction

The mathematics that is delivered in this unit is that which is directly applicable to the engineering industry, and it will help to increase students' knowledge of the broad underlying principles within this discipline.

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

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 problems.

### 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 engineering examples.
2. Investigate applications of statistical techniques to interpret, organise and present data.
3. Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering applications.
4. Examine how differential and integral calculus can be used to solve engineering problems.

## Essential Content

### LO1 Identify the relevance of mathematical methods to a variety of conceptualised engineering examples

*Mathematical concepts:*

Dimensional analysis

Arithmetic and geometric progressions

*Functions:*

Exponential, logarithmic, trigonometric and hyperbolic functions

### LO2 Investigate applications of statistical techniques to interpret, organise and present data

*Summary of data:*

Mean and standard deviation of grouped data

Pearson's correlation coefficient

Linear regression

Charts, graphs and tables to present data

*Probability theory:*

Binomial and normal distribution

### LO3 Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering application.

*Sinusoidal waves:*

Sine waves and their applications

Trigonometric and hyperbolic identities

*Vector functions:*

Vector notation and properties

Representing quantities in vector form

Vectors in three dimensions

## LO4 **Examine how differential and integral calculus can be used to solve engineering problems**

### *Differential calculus:*

Definitions and concepts

Definition of a function and of a derivative, graphical representation of a function, notation of derivatives, limits and continuity, derivatives; rates of change, increasing and decreasing functions and turning points

Differentiation of functions

Differentiation of functions including:

- standard functions/results
- using the chain, product and quotient rules
- second order and higher derivatives

Types of function: polynomial, logarithmic, exponential and trigonometric (sine, cosine and tangent), inverse trigonometric and hyperbolic functions

### *Integral calculus:*

Definite and indefinite integration

Integrating to determine area

Integration of functions including:

- common/standard functions
- using substitution
- by parts

Exponential growth and decay

Types of function: algebraic including partial fractions and trigonometric (sine, cosine and tangent) functions

### *Engineering problems involving calculus:*

Including: stress and strain, torsion, motion, dynamic systems, oscillating systems, force systems, heat energy and thermodynamic systems, fluid flow, AC theory, electrical signals, information systems, transmission systems, electrical machines, electronics

## Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<b>LO1</b> Identify the relevance of mathematical methods to a variety of conceptualised engineering examples		<b>LO1 &amp; LO2</b> <b>D1</b> Present data in a method that can be understood by a non-technical audience
<b>P1</b> Apply dimensional analysis techniques to solve complex problems	<b>M1</b> Use dimensional analysis to derive equations	
<b>P2</b> Generate answers from contextualised arithmetic and geometric progressions		
<b>P3</b> Determine solutions of equations using exponential, logarithmic, trigonometric and hyperbolic functions		
<b>LO2</b> Investigate applications of statistical techniques to interpret, organise and present data		
<b>P4</b> Summarise data by calculating mean and standard deviation	<b>M2</b> Interpret the results of a statistical hypothesis test conducted from a given scenario	
<b>P5</b> Calculate probabilities within both binomially distributed and normally distributed random variables		

Pass	Merit	Distinction
<b>L03</b> Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering application		<b>D2</b> Model the combination of sine waves graphically and analyse the variation in results between graphical and analytical methods
<b>P6</b> Solve engineering problems relating to sinusoidal functions <b>P7</b> Represent engineering quantities in vector form, and use appropriate methodology to determine engineering parameters	<b>M3</b> Use compound angle identities to combine individual sine waves into a single wave	
<b>L04</b> Examine how differential and integral calculus can be used to solve engineering problems		<b>D3</b> Analyse maxima and minima of increasing and decreasing functions using higher order derivatives
<b>P8</b> Determine rates of change for algebraic, logarithmic and trigonometric functions <b>P9</b> Use integral calculus to solve practical problems relating to engineering	<b>M4</b> Formulate predictions of exponential growth and decay models using integration methods	

## 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

<http://www.mathcentre.ac.uk/> Maths Centre  
(Tutorials)

<http://www.mathstutor.ac.uk/> Maths Tutor  
(Tutorials)

### Links

This unit links to the following related units:

*Unit 39: Further Mathematics*