

BTEC

HIGHER NATIONALS

Engineering

**Higher National
Certificate Lvl 4**

 **Pearson**

Unit 2: Engineering Maths

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

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

Pass	Merit	Distinction
L03 Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering application	M3 Use compound angle identities to combine individual sine waves into a single wave	D2 Model the combination of sine waves graphically and analyse the variation in results between graphical and analytical methods
P6 Solve engineering problems relating to sinusoidal functions P7 Represent engineering quantities in vector form, and use appropriate methodology to determine engineering parameters		
L04 Examine how differential and integral calculus can be used to solve engineering problems	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
P8 Determine rates of change for algebraic, logarithmic and trigonometric functions P9 Use integral calculus to solve practical problems relating to engineering		

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