BTEC

HIGHER NATIONALS

Construction

Higher National Certificate Lvl 4

Pearson

Unit 8: Mathematics for Construction

NOTE: This unit replaces K/615/1394 and is only suitable for students **registered FOR the 2019/20 (or later) academic year**.

For students **registered BEFORE the 2019/20 academic year**, please use K/615/1394 found in *Appendix 7: Legacy Units*.

Unit code	**J/617/6366**
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 Construction, 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: trigonometry and algebraic mathematical techniques; matrices; statistical techniques; differential and integral calculus, binomial and normal distribution; dimensional analysis, arithmetic progressions; vector analysis.

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

Learning Outcomes

By the end of this unit, a student will be able to:

1 Use analytical and computational methods to solve construction related problems

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

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

4 Use mathematical methods to solve vector analysis, arithmetic progression and dimensional analysis examples.

Essential Content

LO1 **Use analytical and computational methods to solve construction related problems**

Analytical methods

Trigonometry

irregular areas and volumes

sine rule

cosine rule

area of triangles applications

Trigonometry

coordinate systems

basic trigonometric ratios and their inverses

trigonometric ratios for the four quadrants

solution of triangles

areas and volumes of regular solids

Algebra

Linear

simultaneous and quadratic equations (graphical or algebraic solving)

Matrices

Multiplication

Transposition

inversion (up to 2 x 2)

Application to construction problems

analysis and design issues

processes and operations

resource issues e.g. labour, finance

project planning

levelling, contouring

triangulation, traversing, cut and fill, setting out.

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

Statistical methods

presentation of data (histograms, frequency graphs, cumulative frequency graphs)

Central tendency and dispersion

dispersion (standard deviation, variance, interquartile range)

Distribution theory: normal distribution

confidence limits

Null hypothesis

significance testing.

Construction engineering problems

measures of central tendency (mean, mode, median)

measures of dispersion (range, variance, standard deviation, quartiles, deciles and percentiles)

grouped and ungrouped data

Probability theory, Binomial and normal distribution

Applications

presentation of data

estimation

prediction

quality control

LO3 **Illustrate the wide-ranging uses of calculus within different construction disciplines by solving problems of differential and integral calculus**

Differential calculus

basic differentiation techniques applied to algebraic, trigonometric and logarithmic functions

products and quotients

function of a function

second order derivatives

the location of stationary values

Integral calculus

indefinite and definite integration techniques applied to algebraic, trigonometric and exponential functions

Practical construction problems

solution of problems involving maxima and minima

growth and decay

centroids

moments of inertia

areas under curves and volumes of revolution

use in electrical theory, structural mechanics, fluid mechanics as appropriate.

LO4 **Use mathematical methods to solve vector analysis, arithmetic progression and dimensional analysis problems.**

Trigonometrical techniques

Vector analysis e.g. static forces, relative motion, frameworks

Arithmetic progressions

Dimensional analysis

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Use analytical and computational methods to solve construction related problems</td><td rowspan="5">LO1 and LO2

D1 Evaluate analytical and statistical findings from construction problems completed and justify the techniques adopted to solve such problems.</td></tr>
<tr><td>P1 Solve construction problems using trigonometry techniques

P2 Solve construction problems using algebraic techniques</td><td>M1 Apply the use of matrices to solve problems</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>P3 Apply statistical methods, including the calculation of the mean and standard deviation, to produce accurate and appropriate solutions to construction engineering problems

P4 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>
</table>

Pass	Merit	Distinction
LO3 Illustrate the wide-ranging uses of calculus within different construction disciplines by solving problems of differential and integral calculus		
P5 Use differential calculus techniques to solve functions which incorporate: ax^n, sine ax, cosine ax, $\log_e x$, e^{ax} and methods including function of a function **P6** Use integral calculus techniques to determine indefinite and definite integrals of functions involving ax^n, sine ax, cosine ax, 1/x, and e^{ax}	**M3** Apply the rules of integral calculus to determine solutions for complex construction related problems	**D2** Analyse differential calculus techniques in the determination of maxima and minima in construction industry-related problem.
LO4 Use mathematical methods to solve vector analysis, arithmetic progression and dimensional analysis examples.		
P7 Apply dimensional analysis to solve problems **P8** Generalise answers from a contextualised arithmetic progression problems	**M4** Solve construction problems using vector analysis	**D3** Evaluate the effectiveness and relevance, to the solving of complex construction problems, of the mathematical technique of vector analysis

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 (Tutorials)
mathtutor.ac.uk	Mathtutor (Tutorials)

Links

This unit links to the following related units:

Unit 9: Principles of Heating Services Design & Installation

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

Unit 33: Advanced Electrical Design & Installation

Unit 43: Hydraulics