

Mathematical Techniques for Engineers A

DCM-1-163

Faculty of Engineering, Science and the Built Environment

2008-9



become what you want to be

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1.0 UNIT DETAILS

Unit Title:	Mathematical Techniques for Engineers
Unit Level:	1
Unit Reference Number:	DCM_1_163
Credit Value:	15 CAT
Student Study Hours:	150
Contact Hours:	50
Private Study Hours:	100
Pre-requisite Learning (If applicable):	-
Co-requisite Units (If applicable):	BTEC HND Building Services Engineering
Course(s):	BSc Building Services Engineering
Year and Semester Unit Coordinator: UC Contact Details (Tel, Email, Room) Teaching Team & Contact Details: Subject Area: Summary of Assessment Method:	BEng (Hons) Building Services Engineering 1, semesters 1 and 2 Dr Alan Dunn 020 7815 7133, <u>alan.dunn@lsbu.ac.uk</u> , T-616 Tutorials: Steve Faulkner <u>faulknsj@lsbu.ac.uk</u> MMCE 40% examination, 60% coursework

2.0 SHORT DESCRIPTION

This unit introduces the main mathematical techniques which are required in the early stages of engineering degrees. The topics include complex numbers, trigonometry, calculus, curve sketching, and matrix and vector algebra. The unit is delivered over two semesters. The material to be covered in semester 1 is identical to that delivered in semester 1 of *DCM_1_164 Mathematical Techniques for Engineers B*.

3.0 AIMS OF THE UNIT

This unit aims to:

- 1) accommodate a variety of mathematical backgrounds, and different mathematical knowledge bases. Consequently, the emphasis of this unit is on subject consolidation;
- 2) provide the student with a range of mathematical skills which underpin a range of engineering disciplines.

4.0 LEARNING OUTCOMES

4.1 Knowledge and Understanding

The student will be able to demonstrate knowledge of a range of mathematical techniques and an understanding of their application in an engineering context.

4.2 Intellectual Skills

The student will be able to apply appropriate quantitative mathematical techniques to the analysis of problems.

4.3 Practical Skills

The student will:

- 1) be confident and competent in the application of a range of arithmetic and algebraic techniques including operations on matrices, vectors and complex numbers
- 2) be able to solve equations involving linear, quadratic, trigonometric and exponential functions and be able to sketch these elementary functions.
- 3) be able to differentiate and integrate functions of a single variable and identify and classify stationary points.

4.4 Transferable Skills

The student will acquire rigour in developing an individual preferred learning style and strategy

5.0 ASSESSMENT OF THE UNIT

- 60%: consisting of a two hour phase test at the end of Semester 1 and a course work in semester 2.
- 40%: a closed book, two hour examination at the end of the unit i.e. at end of Semester 2. All questions should be attempted.

The minimum pass mark for the unit is 40%. The minimum pass mark for each component is 30%.

6.0 INTRODUCTION TO STUDYING THE UNIT

6.1 Overview of the Main Content

CORE MATERIAL (in common with *Mathematical Techniques for Engineers B*) ALGEBRA: rules of algebra, use of brackets, hierarchy of calculation; the real number line; position of the fundamental constants **e**, π and ∞ ; examples of numbers raised to positive, negative and fractional powers; logarithms and indices rules.

FUNCTIONS: functions of a single variable. Brief ideas on limits, continuity, single valuedness, roots, gradients; properties of standard functions: exponential, logarithmic and trigonometric functions; growth, decay and wave like behaviour; sketching elementary functions; polynomials: facts about polynomials, *nth* degree polynomial has *n* roots, real and complex roots, complex conjugate pairs; rational functions; thorough treatment of linear, quadratic, cubic equations.

SERIES: binomial theorem, introduction to sequences and series; power series representation of a function; simple properties of power series; radius of convergence.

COMPLEX NUMBERS: graphical representation, Cartesian and polar form, elementary operations of addition, subtraction, multiplication.

VECTOR ALGEBRA: scalars and vectors, unit vectors, addition and subtraction of vectors.

CALCULUS: rates of change; definition of a derivative, geometrical interpretation; basic rules; stationary points; integration as area under a graph.

STATISTICS: mean, mode, variation of data.

SEMESTER 2

HANDLING DATA: plotting data on linear-linear, log-log and log-linear graph paper.

FURTHER CALCULUS: product rule, quotient rule, chain rule, parametric and partial differentiation; integration by substitution and by parts; L'Hôpital's Rule; introduction to differential equations.

FURTHER COMPLEX NUMBERS: De Moivre's theorem; power, roots and logarithms; applications of complex numbers: loci.

MATRICES: definition of a matrix; simple matrix algebra and properties; determinants, inverse matrix; application to transformations.

FURTHER TRIGONOMETRY: solving trigonometric equations, engineering waves, trigonometric identities.

6.2 Overview of Types of Classes

A mixture of lectures and smaller group tutorials.

6.3 Importance of Student Self-Managed Learning Time

The student should spend the appropriate amount of time on each topic if he/she aims to pass the unit successfully.

6.4 Employability

Mathematical skills are applicable to a very wide range of professions within engineering disciplines and generally.

7.0 <u>THE PROGRAMME OF TEACHING, LEARNING</u> <u>AND ASSESSMENT</u>

Semester 1

Week	Торіс
1	Basic algebra: numbers, rearranging formulae, brackets.
2	Indices rules, logarithms and exponentials.
3	Functions
4	Differentiation from first principles, basic rules.
5	Integration: basic principles.
6	Integration: definite, area under graph.
7	Trigonometry: angles, trigonometric ratios; functions
8	Trigonometry: identities and equations.
9	Trigonometry: solving triangles.
10	Vectors: addition/subtraction.
11	Vectors: scalar and vector multiplication.
12	Sequences and Series.

Semester 2

Week	Торіс
1	Complex Numbers: graphical and Cartesian form.
2	Complex Numbers: polar form.
3	Complex Numbers: roots, solving equations.
4	Taylor and Maclaurin Series.
5	Matrices: basic algebra.
6	Matrices: determinants, inverses; transformations.
7	Statistics: mean, mode, standard deviation.
8	Differentiation techniques: product and chain rule.
9	Differentiation: curve sketching/stationary points.
10	Integration: by parts, by substitution.
11	Differential equations.

A more detailed programme is available on Blackboard.

8.0 LEARNING RESOURCES

8.1 Core Materials

Croft, A. and Davison, R. (2008) *Mathematics for Engineers: A modern Interactive Approach.* 3rd Edition, Pearson Educational. ISBN-13: 978-0-132-05156-9 [510.2462 CRO 10 copies] *This is the key text for the unit and you are expected to purchase a copy.*

8.2 Optional Materials

Stroud, K. A. and Dexter, J. B. (2007) *Engineering Mathematics.* 6th Edition, Palgrave MacMillan. ISBN-13: 978-1-403-94246-3 [510.2462 STR 25 copies 5th edition]

Jordan, D. W. and Smith, P. (2002) *Mathematical Techniques: An Introduction for the Engineering, Physical, and Mathematical sciences.* 3rd Edition, Oxford University Press. ISBN-13: 978-0-199-28201-2 [510.2462 JOR 10 copies]

(Additional online resources are available on the Blackboard site.)

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