London South Bank University

EST 1892

Module Guide

Engineering Mathematics and Modelling

ENG_4_401

School of Engineering

Level 4

Table of Contents

1. MODULE DETAILS

Module Title:	**Engineering Mathematics and Modelling**
Module Level:	4
Module Reference Number:	ENG_4_401
Credit Value:	20
Student Study Hours:	200
Contact Hours:	60
Private Study Hours:	140
Pre-requisite Learning (If applicable):	Foundation/'A' Level Mathematics or Equivalent
Co-requisite Modules (If applicable):	none
Course(s):	BEng Common Engineering Programmes
Year and Semester	2018/19 Semester 1 and Semester 2
Module Coordinator:	Dr. J.M. Selig
MC Contact Details (Tel, Email, Room)	020 7815 7461, seligjm@lsbu.ac.uk, T811
Teaching Team & Contact Details (If applicable):	Mr Stavros Dimitriou, dimitrsa@lsbu.ac.uk, T813 Dr. Nigel Webster, webstenl@lsbu.ac.uk, T809 Mr. Ridouan Chaouki, chaoukir@lsbu.ac.uk, T415
Subject Area:	Engineering
Summary of Assessment Method:	50% Semester 1 Exam 50% End of Year Exam
External Examiner appointed for module:	Prof. Danny Morton, University of Bolton, UK

2. SHORT DESCRIPTION

This module consolidates the mathematical skills that underpin the BEng engineering degrees. It is specifically designed to cater for the wide differences in mathematical background of 1st year London South Bank Engineering students, as well as to prepare students for the Advanced Engineering Mathematics and Modelling module taken in the 2nd year

3. AIMS OF THE MODULE

The module's aims are as follows

- To consolidate the student's knowledge and understanding of a broad range of mathematical methods and techniques appropriate for engineering courses.
- To provide the student with the core skills that enables him/her to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems.
- To prepare the student for the Advanced Engineering Mathematics and Modelling module taken in the 2nd year

4. LEARNING OUTCOMES

4.1 Knowledge and Understanding

On successful completion of the module, students will:

- be able to understand and perform a range of algebraic operations including operations on complex numbers in various forms;

- be able to differentiate and integrate functions of one real variable using a variety of techniques;
- understand how calculus is used to model changes in engineering systems;
- be able to sketch the elementary functions (e.g. linear, quadratic, cubic, exponential, logarithmic, rational and trigonometric);
- be able to sketch piecewise functions;
- understand how calculus is used to model changes in engineering systems including applications

4.2 Intellectual Skills

On successful completion of the module, students will:

- understand the real number line and the complex plane;
- be able to interpret solutions to mathematical equations;
- engage in technical discussion in a multi-cultural environment;
- gain experience in communicating mathematics clearly and succinctly;
- be able to sketch functions using analysis.

4.3 Practical Skills

On successful completion of the module, students will be able to

- solve a range of engineering problems using vector and matrix algebra;
- apply statistics and calculus to a range of engineering problems;
- to present mathematical solutions using efficient and concise mathematical techniques

4.4 Transferable Skills

On successful completion of the module, students will be able to

- understand the need to “learn mathematics by doing” and to schedule their time accordingly;
- recognise familiar patterns in unfamiliar pictures;
- use sketches, diagrams as an aid to understanding complex problems;
- classify problems and choose an appropriate solution method;
- transfer ideas and methods from one situation to a different situation.

5. ASSESSMENT OF THE MODULE

50% - Course Work in the form of an Exam at the end of Semester 1 (On topics covered in Semester 1)
50% - An examination at the end of semester 2 (On topics covered in Semester 2)

6. FEEDBACK

Feedback will normally be given to students 15 working days after the final submission of an assignment or as advised by their module leader.

General feedback, applying to all students, will also be placed on the module VLE site within 15 working days.

7. INTRODUCTION TO STUDYING THE MODULE

7.1 Overview of the Main Content

Revision of elementary algebra

The module will provide for some revision of elementary algebra. For example rules of indices, logarithms, transposition of formulae, factorisation, surds and solving simultaneous equations.

Differential and Integral Calculus and Applications

- Differentiation of elementary functions
- Differentiation of products and composite functions
- Sketching the elementary functions (e.g. algebraic and trigonometric)
- Definite and indefinite integrals:
- Integration of elementary functions
- Application to areas, means, variances and various engineering problems
- Maclaurin and Taylor series
- Limits, continuity, and piecewise functions.
- Differentiation of implicit and parametric functions.
- Further sketching of functions using properties of transformations and using calculus (rational functions and piecewise functions).
- Modulus, odd and even functions, inverse function
- Integration by change of variable, partial fractions, by parts and by substitution
- Solution of first order differential equations by separation of variables

Complex Numbers:

- Graphical representation: Cartesian, polar and exponential form
- Elementary operations: Addition, subtraction, multiplication, division
- De Moivre's theorem
- Power, roots and logarithms
- Applications of complex numbers: Loci

Introduction to Linear Algebra

- Scalars and vectors
- Vectors addition, subtraction
- Dot product
- Matrix addition and multiplication
- Inverse and determinant of a matrix (2-D)
- Vector cross product
- Inverse and determinant of a matrix (3-D)
- Solution of simple linear simultaneous equations in 2-D and 3-D

Handling Data:

- Statistics:
- Data averages and data variation
- Elementary probability
- Probability density function and distributions.

Numerical Methods

- An introduction to solving equations with no analytic solution
- The use of the ‘Interval Bisection’ method
- The use of the ‘Fixed Point Iteration’ method
- The use of the ‘Newton Raphson’ method

Trigonometry

- A review of the trigonometric functions cosine, sine and tangent
- An introduction to the reciprocal trigonometric functions secant, cosecant and cotangent

The use of degrees and radians in solving simple trigonometric equations

7.2 Overview of Types of Classes

The course will be composed of lectures and tutorials, which are complemented by a comprehensive set of accompanying notes, worked solutions as well as mathematical aids (e.g. revision cards, video footage of worked examples) to help the student maximise their capacity to learn and do mathematics

7.3 Importance of Student Self-Managed Learning Time

Student responsibility in the learning and development process will be emphasised. Students are required to undertake directed self-study and prepare solutions/discussions to questions relative to various topic areas. Students will be encouraged to identify for themselves particular problems of difficulty and to use seminar discussions, where appropriate, for the resolution of these. Students must regularly access the Moodle site for this module. They should download the class/lecture material from the Moodle site, and do the recommended reading, before each lecture/class.
Where appropriate, students are also expected to download the relevant seminar questions and study them in advance of each seminar, in order to derive maximum benefit from seminar time. The programme of teaching, learning and assessment gives guidance on the textbook reading required for each week, the purpose of which is to encourage further reading both on and around the topic.

7.4 Employability

This is a Core Subject for all BEng(Hons) engineering students, and as such is a necessary module for continuing into the second year and enhancing the opportunity for work experience and eventual employment.

8. THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

SEMESTER 1		
WEEK Beginning	TOPIC	READING (CORE TEXT)
1. 24/09/18	Number and Arithmetic: Number line, fractions rules of arithmetic, surds,	Lecture 1
2. 01/10/18	Exponentials and Logarithms: Rules, properties and examples	Lecture 2
3. 08/10/18	Algebra: Linear & quadratic equations, simultaneous equations, transposition of formulas	Lecture 3
4. 15/10/18	Trigonometry: Basic definitions, degrees, radians, definitions and graphs of cos, sin and tan	Lecture 4
5. 22/10/18	Functions: Sketching and properties of linear, quadratic and cubic, mod, odd, even, inverse	Lecture 5
6. 29/10/18	Algebra of Functions: Limits, continuity, piecewise, sketching using transformations, irrational & piecewise	Lecture 6
7. 05/11/18	Differentiation: Elementary functions, products, quotients and composite, forms of dy/dx	Lecture 7
8. 12/11/18	Further Differentiation: Maximum and minimum optimisation, implicit, parametric and partial	Lecture 8
9. 19/11/18	Approximating Functions: Maclaurins and Taylor series	Lecture 9
10. 26/11/18	Integration: Area under a Curve, definite and indefinite integras, the fundamental theorem of calculus	Lecture 10
11. 03/12/18	Techniques of Integration: Integration by parts, by	Lecture 11

	substitution, partial fractions, trigonometric identities	
12. 10/12/18	Revision	

SEMESTER 2		
WEEK	TOPIC	READING (CORE TEXT)
1. 28/01/19	First Order Differential Equations:Linear equations with constant coefficients, initial value problems	Lecture 12
2. 04/02/19	Second Order Differential Equations: Complementary function and particular integral, initial value and boundary problems.	Lecture 13
3. 11/02/19	Complex Numbers: Elementary Operations: Addition, Subtraction, Multiplication, Division	Lecture 14
4. 18/02/19	More Complex Numbers: Graphical Representation in Cartesian, Polar and Exponential form	Lecture 15
5. 25/02/19	Some Applications of Complex Numbers: De Moivres Theorem, Power , Roots, Logarithms and Loci	Lecture 16
6. 04/03/19	Introduction to Vectors: scalars, definitions and examples, addition of vectors, bases and dimension.	Lecture 17
7. 11/03/19	Products of Geometric Vectors: Dot product, vector product and applications	Lecture 18
8. 18/03/19	Introduction to Matrices: Matrix definition, addition and multiplication, transpose	Lecture 19
9. 25/03/19	Linear Algebra: Inverse and Determinant of a matrix (2-D and 3-D), Solutions of Linear Equations	Lecture 20
10. 1/04/19	Some Numerical Methods: Roots of Equations: Interval Bisection, Fixed Point, Newton Raphson	Lecture 21
Easter Vacation 8/04/19 – 26/04/19		
11. 29/04/19	Statistics: Types of data, averages and measures of variation.	Lecture 22
12. 06/05/19*	Revision	

*6/05/18 is a Bank Holiday, Monday classes will take place in week 13

9. STUDENT EVALUATION

Few students filled out the online, end of module questionnaire. I take this to indicate that most students were generally satisfied. Most of the responses seemed to be positive.

10. LEARNING RESOURCES

Reading List

The core reading for this module is the set of notes posted on the Moodle site for the module.

Optional reading

1. A Croft and R Davison, “Mathematics for Engineers, A Modern Interactive Approach”, 3rd Edition, 2008, Pearson, Prentice Hall. (ISBN: 978-0-13-205156-9)
2. A Croft and R Davison, “Foundation Mathematics”, 5th Edition, 2010, Prentice Hall.
   a. (ISBN: 978-0-273-72940-2)
3. K. A Stroud, “Further Engineering Mathematics”, 1990, Macmillan Education.
4. L Bostock and S Chandler, “Core Maths for Advanced Level”, 2000, Stanley Thornes.

5. L Bostock and S Chandler, “Further Pure Mathematics”, 1982, Thornes.

Note: many other books covering more or less the same material are available and can be consulted.