**Short Form Module Details**

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| Module Title | **Engineering Mathematics and Modelling B** |
| Level | First Year Undergraduate |
| Reference No.*(showing level)* | EEC\_4\_002 |
| Credit Value | 30 CAT points |
| Student Study Hours | Total learning hours: 300 hoursContact hours up to 100 hoursStudent managed learning hours: 200 hours or more |
| Pre-requisite learning | None |
| Co-requisites | None |
| Excluded combinations | None |
| Module co-ordinator | George A Georgiou |
| Faculty/Department | Engineering, Science and the Built Environment |
| Short Description | This module consolidates the mathematical skills that underpin all the BEng(Hons) engineering degrees, but also includes those students studying BTEC HND Building Services Engineering and BSc Building Services Engineering. It is specifically designed to cater for the wide differences in mathematical background of first year London South Bank Engineering students. All those undertaking a BEng(Hons) engineering degree, including the additonal courses above, will be studying all the elements of the ‘Advanced Only’ part of this module. The ‘Advanced Only’ elements in this module are in essence the parts that differentiate this module from the module ‘Engineering Mathematics and Modelling A’ |
| Aims | This module's aims are as follows* To consolidate the student's knowledge and understanding of a broad range of mathematical techniques appropriate for engineering courses.
* To provide the knowledge and skills that enables the student to use computer software and programming as a support for his/her engineering studies.
* 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.
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| Learning Outcomes | **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;
* be able to apply quantitative methods and computer software relevant to engineering.

ADVANCED ONLY* be able to sketch piecewise functions and rational functions;
* understand how calculus is used to model changes in engineering systems including applications involving partial derivatives.

**Intellectual Skills**On successful completion of the module, students will:* understand the real number line and the complex plane;
* be able to structure and decompose mathematical problems by means of a computer program;
* engage in technical discussion in a multi-cultural environment;
* gain experience in communicating mathematics clearly and succinctly;

ADVANCED ONLY* be able to sketch functions using analysis.

**Practical Skills**On successful completion of the module, students will be able to* solve engineering problems using vector and matrix algebra;
* apply statistics and calculus in engineering problems;
* use mathematical software such as MATLAB and MATHCAD to plot functions and solve equations
* debug faulty program designs.

ADVANCED ONLY* use software to model and analyse engineering problems.

**Transferable Skills**On successful completion of the module, students will be able to* use a logbook as an effective learning aid;
* understand the need to “learn by doing” and to schedule their time accordingly;
* recognise familiar patterns in unfamiliar pictures;
* write computer programmes that reduce the time and tedium of manual calculation;
* use sketches, diagrams and software as an aid to understanding complex problems;

ADVANCED ONLY* classify problems and choose an appropriate solution method;
* transfer ideas and methods from one situation to a different situation.
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| Employability | This is a Core Subject for all BEng(Hons), BTEC HND Building Services and BSc Building Services 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 |
| Teaching and learning pattern | 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 |
| Indicative content | **Overview of the Main Content****Revision of elementary algebra**he module will provide for some revision of elementary algebra, for example indices rules, logarithms, transposition of formulae, factorisation, surds, solving simultaneous equations. **Differential and Integral Calculus and Applications*** Differentiation of elementary functions.
* Differentiation of products and composite functions
* Sketching the elementary functions
* Definite and indefinite integrals:
* Integration of elementary functions
* Application to areas, means, variances and various engineering problems
* Maclaurin series

ADVANCED ONLY:* Limits, continuity, and piecewise functions.
* Differentiation of implicit and parametric functions.
* Partial differentiation
* Further sketching of functions using properties of transformations and using calculus (rational functions and piecewise functions).
* Modulus, odd and even functions, inverse function
* Taylor series
* 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.

  ADVANCED ONLY:* 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)

ADVANCED ONLY: * Vector cross product
* Inverse and determinant of a matrix (3-D)

**Handling Data:** * Statistics:
* Data averages and data variation
* Elementary probability

 ADVANCED ONLY:* Probability density function and distributions.

**Computer software*** Introduction to analytical software packages to handle engineering problems.
* Solving equations using software
* Plotting functions, plotting data, statistics and applications
* Symbolic algebra.
* Arrays and Strings. Data Types, script files. Conditional Loops.

**Program Design*** Problem solving using structured design and structured programming.
* Top-down design, functional decomposition, modular programming.
* Use of flow charts within consistent software design methodology.
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| Assessment*Elements & weightings* | This module shall be assessed as follows:* 50% end of year examination.
* 50% continual assessment. This could include a phase test, online test, and /or assignment.
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| Indicative Sources*(Reading lists)* | **CORE:**1. Mathematics for Engineers, A Modern Interactive Approach: A Croft and R Davison, (Pearson, Prentice Hall, 3rd Edition, 2008)

**REFERENCE:**1. Foundation Mathematics: A Croft and R Davison, (Prentice Hall,5th Edition, 2010)
2. Engineering Mathematics: Programmes and Problems: K. A Stroud**,** (Basingstoke : Macmillan, 1995)
3. Further Engineering Mathematics: K. A Stroud, (Macmillan Education, 1990)
4. Core Maths for Advanced Level: L Bostock and S Chandler, (Stanley Thornes, 2000)
5. Further Pure Mathematics: L Bostock and S Chandler, (Thornes 1982)
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