Mathematical Skills for the Offshore Engineering Masters Programme

1 Introduction

This document gives a brief description of the mathematical skills expected from candidates for the Masters programmes in the School of Engineering. It is intended for people considering applying for one of the courses as a guide for what to expect from some of the modules on the course.

The entry requirements for all of the M.Sc. programmes include holding an undergraduate degree in Engineering. Taught masters degrees use the mathematical skills learned during undergraduate study to build new and more advanced learning in a variety of subjects including materials science, reliability modelling, communications theory and control to name a few.

The standard textbook used by many institutions for undergraduate engineering courses in the U.K. is K. A. Stroud's book “Engineering Mathematics” [1]. The textbook is split into two parts. The first deals with foundation issues of mathematics and contains 12 sections. The second part contains 28 separate learning programmes on a range of topics required by engineers. Part 1 reviews some of the main topics learned up to Higher and A-Level in the U.K. while Part 2 constitutes the new material that is learned during a university undergraduate degree. One or two more advanced topics are contained in a second volume “Advanced Engineering Mathematics” [2].

The next section of this document sets out some of the most important topics that will be used to some extent during the M.Sc. modules. A brief description of each topic is given, together with the relevant section of [1] and [2].
2 Mathematical Content

The following topics in Stroud are of particular importance:

- **Foundation Mathematics:** Arithmetic; algebra; equations; graphs; linear equations and simultaneous linear equations; polynomial equations; partial fractions; trigonometry; binomial series; differentiation; integration; functions.
  - All of Part 1, pages 1–434 of reference [1].

- **Complex Numbers:** Uses of the number $j = \sqrt{-1}$, particularly in the description of random functions and hyperbolic functions. Applied in dynamics and control theory problems.
  - Programmes 1 and 2, pages 437–494 of reference [1].

- **Determinants:** Solution methods for simultaneous equations. Used for aspects of solid mechanics, structural engineering and control.
  - Programme 4, pages 521–554 of reference [1].

- **Matrices:** More advanced solution methods for groups of simultaneous equations. Used in reliability theory; solid mechanics; finite element methods; control theory.
  - Programme 5, pages 555–589 of reference [1].

- **Scalars, Vectors and Tensors:** Description of physical quantities in engineering systems. Required for numerical subjects; Tensors required for aspects of solid mechanics.

- **Differentiation and Partial Differentiation:** Rates of change form the basis of much of mechanics and the dynamics of engineering systems.
  - Programme 7–11, pages 619–728 of reference [1].

- **Integration - Direct and Approximate Solutions:** Application of integration to engineering problems including area under a function; mean values of functions; RMS values of functions; surfaces of revolution; volumes of revolution; locating centroids; moments of inertia; second moments of area.
  - Programmes 15 and 16 for integration theory pages 823–884 of reference [1];
  - Applications in programmes 18–20 pages 901–979 of reference [1];
  - Approximate integration in program 21 pages 981–1000 of reference [1].

- **Multiple Integrals:** Multiple integrals used to describe multi-dimensional systems including structural analysis; reliability theory.
  - Programme 23, pages 1025–1049 of reference [1].

- **Polar Co-ordinates:** Use of polar co-ordinate system to describe behaviour of engineering systems.
  - Programme 22, pages 1001–1024 of reference [1].
• **Differential equations and Laplace transforms**: Used for the description of dynamic behaviours of engineering systems. Laplace Transforms used as solution method for certain types of differential equations.
  
  – Programmes 24–26, pages 1051–1138 of reference [1].

• **Fourier transforms**: Mapping of time domain functions into frequency domain using Fourier pairs. Use of both real and imaginary components for signals analysis; random functions and dynamics.
  
  – Programmes 6 and 7, pages 172–276 of reference [2].

• **Probability theory and statistics**: Probability calculus used to describe physical and knowledge based uncertainties in engineering systems. Used in reliability theory. Statistics used in failure data analysis and collection of data from engineering systems.
  
  – Programmes 27 and 28 of reference [1].

The above list should not be taken as definitive, but as a guide to prospective applicants in understanding the level of maths skills required in some of the taught courses in M.Sc. programmes delivered by the School of Engineering.

Applicants should be prepared to have this knowledge assessed if they have not done so already through an undergraduate level course. In this case, the list should be used as a guide for self-study; a task for which “Engineering Mathematics” is well designed.

**References**


Reading List for the Offshore Engineering Masters Programme

1 Introduction

This document provides an initial reading list for each course on the Offshore Engineering Masters Programme. The list is not exhaustive, as the course coordinators and lecturers may suggest additional references. However, these lists aim to provide an introduction to the material presented on each course.

Depending on your route through the programme:

- Campus-based students beginning their studies in September will start with Offshore Structures and Subsea Systems, Subsea Construction, Inspection and Maintenance, and Electrical Systems for Renewable Energy and additionally, one course from Subsea Controls and Subsea Integrity;
- Online-learning students beginning their studies in September will start with Offshore Structures and Subsea Systems and Subsea Construction, Inspection and Maintenance;
- Individual subject studies students may tackle the courses in any order (in consultation with the Programme Coordinator and the admissions team).

2 Programme structure

<table>
<thead>
<tr>
<th>Course title</th>
<th>Campus</th>
<th>Online learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offshore Structures and Subsea Systems</td>
<td>EG50R1</td>
<td>EG502T (year 1)</td>
</tr>
<tr>
<td>Subsea Construction, Inspection and Maintenance</td>
<td>EG50T7</td>
<td>EG50T8 (year 1)</td>
</tr>
<tr>
<td>Electrical Systems for Renewable Energy</td>
<td>EG501H</td>
<td>EG504B (year 2)</td>
</tr>
<tr>
<td>and either Subsea Controls</td>
<td>EG50F6</td>
<td>EG50G6 (year 2)</td>
</tr>
<tr>
<td>or Subsea Integrity</td>
<td>EG50F8</td>
<td>EG50G8 (year 2)</td>
</tr>
<tr>
<td>Engineering Risk and Reliability Analysis</td>
<td>EG55P6</td>
<td>EG55Q2 (year 1)</td>
</tr>
<tr>
<td>Marine and Wind Energy</td>
<td>EG552U</td>
<td>EG552V (year 1)</td>
</tr>
<tr>
<td>Marine Environmental Impact Assessment</td>
<td>ZO5516</td>
<td>ZO5514 (year 2)</td>
</tr>
<tr>
<td>and either Renewable Energy Integration of Grid</td>
<td>EG551K</td>
<td>EG55M5 (year 2)</td>
</tr>
<tr>
<td>or Pipelines and Soil Mechanics</td>
<td>EG55F2</td>
<td>EG55G2 (year 2)</td>
</tr>
<tr>
<td>Individual Project in Offshore Engineering</td>
<td>EG5918</td>
<td>EG5919 (year 2/3)</td>
</tr>
</tbody>
</table>
3 Courses running between September and December

Remote access to electronic copies of the texts highlighted in red is available from the University of Aberdeen Library.

EG50R1/EG502T – Offshore Structures and Subsea Systems


EG50T7/EG50T8 – Subsea Construction, Inspection and Maintenance


EG501H/EG504B – Electrical Systems for Renewable Energy


EG50F6/EG50G6 – Subsea Controls – Optional course


EG50F8/EG50G8 – Subsea Integrity – Optional course


4 Courses running between January and May

Remote access to electronic copies of the texts highlighted in red is available from the University of Aberdeen Library.

EG55P6/EG55Q2 – Engineering Risk and Reliability Analysis


EG552U/EG552V – Marine and Wind Energy


ZO5516/ZO5514 – Marine Environmental Impact Assessment


EG551K/EG55M5 – Renewable Energy Integration of Grid – Optional course


EG55F2/EG55G2 – Pipelines and Soil Mechanics – Optional course


5 Other courses/materials

EG5918/EG5919 – Individual Project in Offshore Engineering

Reading lists will be determined on a project-by-project basis, in discussion with the project supervisor.

Engineering mathematics background reading

These references cover the basic engineering mathematics, which might be encountered on any of the courses in the programme. Further details can be found in the Maths Skills document for the Offshore Engineering Masters Programme.


6 Getting started with University of Aberdeen library resources

Once your registration as a University of Aberdeen student is complete, you will have access to the University Library. Access is available to both campus and online-learning students. The library provides access to a number of electronic resources on this reading list (highlighted in red), which are available for you to remotely access/download as part of the University’s library subscriptions.

To get you started with the library resources, you can download an electronic copy of the *Subsea Engineering Handbook* by Bai and Bai using the following instructions:

1. Navigate a web browser to the University of Aberdeen library catalogue:
   
   [http://primo.abdn.ac.uk](http://primo.abdn.ac.uk);

2. Search for the *Subsea Engineering Handbook* in the "All collections" area;

3. The book should appear at the top of the search results, but if not, then select a search result which has "Full text available";

4. This will bring up a new page with a link titled "Full text available via Elsevier ScienceDirect Books";

5. Clicking on this link will take you to a page where you can download this book.

*Please note that these instructions will not work until your registration as a University of Aberdeen student has been completed. If you are not on the University network, then you can still access these electronic resources, but you may be asked to supply your University username and password before the download starts.*