Mathematical Skills for Masters Programmes

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 MSc 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. Strouds book 'Engineering Mathematics'[1]. The textbook is split into two parts. The _rst 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 undergrad 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 MSc 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; pgs 1-434 of [1].

- **Complex Numbers**: Uses of the number \( \sqrt{-1} \), particularly in the description of random functions and hyperbolic functions. Applied in dynamics and control theory problems. Programmes 1 and 2; pgs 437-494 of [1].


- **Differentiation and Partial Differentiation**: Rates of change form the basis of much of mechanics and the dynamics of engineering systems. Programmes 7-11 pgs 619-728 of [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 revolutions; Volumes of revolutions; Locating centroids; Moments of inertia; Second moments of area. Programmes 15 and 16 for Integration theory pgs 823-884; Applications in Programmes 18-20 pgs 901-979; Approximate Integration in Programme 21 pgs 981-1000 of [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 pgs 1051-1138 of [1].

- **Probability Theory and Statistics**: Probability calculus used 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 [1].

The above list should not be taken as definitive, but is intended to give applicants an insight into the level of understanding required for some of the content present in the MSc programmes in 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


Suggested videos for students to review:

**Recommended Reading – September 2018**

**Oil & Gas Engineering**

- Archer, J.S., Wall, C.G., Petroleum Engineering: Principles and Practice (Graham & Trotman, 1986)
- Dake, L.P. The Practice of Reservoir Engineering (Elsevier, 2001)
- Economides, M. J., Hill A. D., Ehlig-Economides, C.; Petroleum Production Systems (Prentice Hall, 1994)
Invitation to MSc students in the School of Engineering

Many of the MSc programmes hosted in the School of Geosciences are multi-disciplinary, covering elements of earth science, engineering, and mathematics. Our incoming students also have a diverse background, with graduates in geology, physics, engineering, mathematics, economics and business (depending on the programme). This means that we commonly have to teach some subjects from a more basic level than we would like. As part of our commitment to supporting and developing our students, we have introduced a pre-sessional geology course. This course is intended for students on the MSc programmes in Geophysics and Reservoir Engineering, where students do not have a geology background.

We extend this invitation to students undertaking the MSc programmes in either Oil & Gas Engineering or Petroleum Engineering. The course is not compulsory, but we feel that students who undertake it will be better prepared for the start of the teaching term on 10 September. There is no mark for these courses.

Introduction to the Earth Sciences

The course is an introduction to geology, covering the basics of earth science, the Wilson cycle, the history of life, and exploration and resources. This course is recommended for students who have no background in geology. The course tutor is Mike Scotting.

Timing and venues

The course is timetabled for Thursday 6th and Friday 7th September, with a morning session at 10:00 and an afternoon session at 14:00 each day. Each session will last between one and two hours. Please meet in room 118 in Meston Building at 10am prompt. There is a more detailed timetable below.

I look forward to meeting you all in September.

David Muirhead
Director of Geoscience Masters Programmes

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday 6 September</td>
<td>10:00</td>
<td>Basics of earth science</td>
</tr>
<tr>
<td></td>
<td>14:00</td>
<td>The Wilson cycle</td>
</tr>
<tr>
<td>Friday 7 September</td>
<td>10:00</td>
<td>The history of life</td>
</tr>
<tr>
<td></td>
<td>14:00</td>
<td>Exploration and resources</td>
</tr>
</tbody>
</table>