### January 2019 Induction Information

<table>
<thead>
<tr>
<th>Programme of Study</th>
<th>MSc Petroleum Engineering</th>
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<tbody>
<tr>
<td>School</td>
<td>School of Engineering</td>
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<tr>
<td>School Contact</td>
<td>Mrs Debbie McKenzie <a href="mailto:debbie.mckenzie@abdn.ac.uk">debbie.mckenzie@abdn.ac.uk</a></td>
</tr>
<tr>
<td>School Office Location</td>
<td>Room 188, Fraser Noble Building</td>
</tr>
<tr>
<td>School Website</td>
<td><a href="https://www.abdn.ac.uk/engineering/">https://www.abdn.ac.uk/engineering/</a></td>
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### Induction Events from Tuesday 8 to Friday 11 January 2019

<table>
<thead>
<tr>
<th>Day</th>
<th>Event Time, Location and Details</th>
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<tbody>
<tr>
<td><strong>Tuesday 8 January</strong></td>
<td><strong>Pre-sessional Geoscience workshops</strong> - Engineering students are welcome to attend:</td>
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<tr>
<td></td>
<td>10:00 – 12:00 <strong>Introduction to Earth Sciences: Basics of Earth Science</strong> Meston 118</td>
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<td>14:00 – 16:00 <strong>Introduction to Earth Sciences: The Wilson Cycle</strong> Meston 118</td>
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<tr>
<td><strong>Wednesday 9 January</strong></td>
<td><strong>Pre-sessional Geoscience workshops</strong> - Engineering students are welcome to attend:</td>
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<tr>
<td></td>
<td>14:00 – 16:00 <strong>Introduction to Earth Sciences: The History of Life</strong> Meston 118</td>
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<tr>
<td><strong>Thursday 10 January</strong></td>
<td><strong>Programme Induction Meeting (all students must attend)</strong></td>
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<td></td>
<td>Meeting with the programme co-ordinator</td>
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<td></td>
<td>10am, Room FN110 Fraser Noble Building</td>
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<tr>
<td><strong>Friday 11 January</strong></td>
<td><strong>Pre-sessional Geoscience workshops</strong> - Engineering students are welcome to attend:</td>
</tr>
<tr>
<td></td>
<td>10:00 – 12:00 <strong>Introduction to Earth Sciences: Exploration and Resources</strong> Meston 118</td>
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#### Compulsory Generic Skills Workshops

**Wednesday 16th January (Week 25)**
**Using the Library, References & Databases**
14.00 – Sir Duncan Rice Library, Floor 2, PC classroom 1 and 2 (Room 226 / 227).

**Wednesday 20th February (Week 30)**
**Academic Writing & Avoiding Plagiarism**
14.00-16.00 - Sir Duncan Rice Library, 2nd Floor Seminar Room (Room 224).
Mathematical Skills for Masters Programmes

1. Introduction

This document provides a brief highlight of the mathematical skills expected of candidates on the Masters degree programmes in the School of Engineering. Prospective candidate on any of the engineering programmes and specifically petroleum engineering would find the content of this document useful in meeting the Mathematical skills required of some of the modules in the courses.

The entry requirements for all of the MSc programmes include holding an undergraduate degree in Engineering or Science plus few years of relevant work experience. Taught masters degrees use the mathematical skills acquired during the undergraduate study to develop new and more advanced learning in a variety of subjects including reservoir engineering; reservoir modelling and simulation; well and production engineering to name a few.

The standard textbook used by many academic institutions for undergraduate engineering courses in the U.K. is K. A. Stroud’s book 'Engineering Mathematics' [1]. The textbook is divided into two parts. The first part deals with foundation issues of mathematics and contains 12 sections. The second part contains 28 separate learning programs on a range of topics required by engineers. Part 1 reviews some of the main topics learnt up to Higher and A-Level in the U.K. while Part 2 constitutes the new material that is learnt during a university undergraduate degree. The volume ‘Differential Equations’ [2] provides a very useful self-study guide for the basic concepts in several differential equation applications including wave propagation in cylindrical and spherical coordinate systems for well test analysis and design. Further topics are also contained in ‘Advanced Engineering Mathematics’ [3] and ‘VNR Concise Encyclopedia of Mathematics’ [4].

In the next section of this document, you will find some of the most important topics that will be used - to some extent - within the MSc modules.
2. Mathematical Content

The following topics are of particular importance to MSc Petroleum Engineering applicants / students:

- **Foundation mathematics**: arithmetic; algebra; equations; graphs; linear equations and simultaneous linear equations; polynomial equations; partial fractions; trigonometry; binomial series; differentiation; integration; functions.
  
  o All of Part 1; pages 1-434 of [1].

- **Further trigonometry**: plane trigonometry, spherical trigonometry and applications.
  
  o Pages 220 – 261 of ref. [4]

- **Complex numbers**: uses of the number $\sqrt{-1}$, particularly in the description of random functions and hyperbolic functions.
  
  o Programs 1 and 2; pages 437-494 of [1].

- **Determinants**: solution method for simultaneous equations. Required in reservoir and well geometry discretisation; finite difference; finite element method.
  
  o Program 4; pages 521-554 [1].

- **Matrices**: more advanced solution method for groups of simultaneous equations. Required in reservoir geometry discretisation; finite difference; finite element method.
  
  o Pages 373–378 of ref. [4]  
  o Program 5; pages 555-589 of [1].

- **Scalars, vectors and tensors**: description of physical quantities in engineering systems. Required for numerical applications in well, production and reservoir characterisation.
  

- **Differentiation and partial differentiation**: rates of change form the basis of much of the dynamics of flow description in petroleum reservoirs, well, surface and subsurface production facilities.
  
  o Programs 7-11 pages 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. Extensively used in reservoir engineering and simulation, well and production engineering and well test analysis.
  
  o Programs 15 and 16 for integration theory pages 823-884 of [1];  
  o Applications in programs 18-20 pages 901-979 of [1];  
  o Approximate integration in program 21 pages 981-1000 of [1]  
  o Pages 443 – 449 of [4].

- **Multiple integrals**: multiple integrals used in reservoir simulation, well test analysis and geometric description.
  
  o Program 23; pages 1025-1049 of [1]
▪ **Polar co-ordinates**: use of polar co-ordinate system in well planning and design.
  
  - Program 22 pages 1001-1024 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.
  
  - Programs 24-26 pages 1051-1138 of [1].

▪ **Further ordinary differential equations**: integration by means of power series; Gaussian differential equation; Bessel equation and Bessel function for the analysis of wave propagation in cylindrical and spherical coordinate systems for well test analysis and design.
  
  - Pages 512 – 517 of ref [4];
  - Program 5 pages 130-163 of ref. [2].

▪ **Fourier transforms**: mapping of time domain functions into frequency domain using Fourier pairs. Use of both real and imaginary components for well test analysis and reservoir engineering.
  
  - Programs 6 and 7 pages 172-276 of [3].

▪ **Probability theory and statistics**: probability calculus used to describe physical and knowledge based uncertainties in reservoir quantification and production data analysis.
  
  - Programs 27 and 28 of [1].

▪ **Geometry**: plane geometry; solid geometry; descriptive geometry; coordinate geometry; curve sketching; vectors; equation of a circle. Used in well drilling design and completion; directional and deviated well planning.
  
  - Pages 146-220 of ref. [4]

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 MSc 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**


M.Sc. Petroleum Engineering
**Recommended Textbooks for MSc Petroleum Engineering**

**Reservoir 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)
- Blunt, M. J., the Imperial College Lectures in Petroleum Engineering. Volume 2: Reservoir Engineering. (World Scientific Publishing 2017)

**Well engineering**

**Production engineering**

**Petroleum geoscience**

**Reservoir simulation**

**Enhanced oil recovery**

**Well testing**
Pre-sessional Geology course in the School of Geosciences – January 2019 Invitation to MSc Petroleum Engineering 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 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. 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 Dr Catriona Menzies.

Timing and venues

The sessions will run on the following dates/times:-

Tuesday 8 January 2019
10:00 – 12:00 Introduction to Earth Sciences: Basics of Earth Science Meston 118
14:00 – 16:00 Introduction to Earth Sciences: The Wilson Cycle Meston 118

Wednesday 9 January 2019
14:00 – 16:00 Introduction to Earth Sciences: The History of Life Meston 118

Friday 11 January 2019
10:00 – 12:00 Introduction to Earth Sciences: Exploration and Resources Meston 118