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1. Welcome from the Director

On behalf of all members of the academic and support staff I would like to welcome you to the MSc in Advanced Materials Science and Engineering. We hope you will enjoy your year with us, and will benefit from the opportunities our programme offers.

By studying in the Department of Materials at Imperial College, you have become a member of the oldest and largest department of its kind in the UK. We are proud of our internationally-leading research programmes in the synthesis, processing, and modelling of a broad range of materials (metals, ceramics, semiconductors, glasses, ceramic-matrix composites, polymers and functional materials). The research is applied to a wide range of contemporary problems: nuclear power, solid oxide fuel cells, aerospace engineering, biomedical innovations, automotive engineering, communications, electronics, and more. Please feel free to talk to the academics about their research. By carrying out a research project during your time here, you will be making your contribution to our shared success.

The MSc is a stand-alone qualification designed to:

1. Provide you the core skills needed to pursue research and development in materials and related areas.
2. Provide you up-to-date knowledge of major themes in materials.
3. Prepare you for a wide range of careers in materials.

We aim to achieve these goals by:

1. Teaching you about materials characterisation and modelling, offering research seminars for you to attend, and giving you a research project.
2. Allowing you to select a number of options, so you can decide what areas you wish to be knowledgeable in.
3. Providing you with transferrable skills courses and opportunities for industry engagement.

This handbook is designed to inform and help you: time taken now to have a read and familiarise yourselves with its contents will make life easier later. If you have a question about the course, please check the handbook: it should have the answer. Of course, if you think we have missed something, please let us know.

I wish you all the best during your time with us.

Andrew Horsfield

Prof Andrew Horsfield
Course Director
2. People

Here below are the staff you will have regular contact with throughout your MSc degree course:-

MSc Course Director
Prof Andrew Horsfield
Room: B331
Email: a.horsfield@imperial.ac.uk

MSc Course Administrator
Mrs Raj Adcock
Room: G03A
Email: raj.adcock@imperial.ac.uk

MSc Senior Tutor
Prof Alexandra Porter
Room: B341
Email: a.porter@imperial.ac.uk

MSc Admissions Tutor &
Deputy Course Director
Dr Fang Xie
Room: 103
Email: f.xie@imperial.ac.uk

Other people in the Student Office who can also assist you with enquires when the MSc Administrator is not available:

- Miss Harpreet Rajbans: Student Office Administrator

There are also a variety of other staff in charge of teaching who you might need to contact within the Department of Materials:

- **Prof Jason Riley**: Director of Undergraduate Studies (DUGS): Office B337 Bessemer
- **Dr Paul Franklyn**: Undergraduate Senior Tutor: Office G03B
- **Prof David Dye**: Projects Coordinator: Office 1.09
3. Programme Specification

The MSc is split into two main elements: taught and research. The taught element shares modules with the MEng in Materials Science and Engineering. There are two compulsory taught modules, in addition to which you must take five optional modules. It is possible that some students (those who have graduated with a BEng in Materials Science and Engineering from our Department) will already have taken one or both of the compulsory MEng modules: in this case these will be replaced by optional modules. The research element includes the research project plan, a research project (for which you need to write a thesis and give a presentation) and one module on transferrable skills and research training (the Art of Research). All of these are compulsory. The available modules are listed below, with the number of European Transfer Credits (ECTS) given in parentheses.

Note that if you select all 5 options from the nuclear strand and carry out a nuclear related project, you can transfer over to the programme "MSc in Advanced Materials Science and Engineering: Specialising in Nuclear Engineering"

The compulsory taught modules are:

(C1) MSE 452 (302): Material Characterisation (6)
(C2) MSE 467 (317): Materials Modelling (6)

The compulsory research related modules are:

(R1) The Art of Research (3)
(R2) Research Project Plan (8)
(R3) Research Project (37)

In addition to the core modules 5 optional courses must be taken from the following list:

(O01) MSE 457 (307): Engineering Alloys (6)
(O02) MSE 458 (308): Ceramic and Glasses (6)
(O03) MSE 460 (310): Electronic Structure and Optoelectronic Behaviour (6)
(O04) MSE 462 (312): Nanomaterials I (6)
(O05) MSE 309: Polymers and Composites (6)
(O06) MSE 315: Biomaterials (6)
(O07) MSE 404: Modelling Materials with Density-Functional Theory (6)
(O08) MSE 409: Advanced Engineering Alloys (6)
(O09) MSE 410: Advanced Thin Film Manufacturing Technologies (6)
(O10) MSE 411: Electroceramics (6)
(O11) MSE 412: Nanomaterials II (6)
(O12) MSE 413: Advanced Structural Ceramics (6)
(O13) MSE 414: Nuclear Materials (6)
(O14) MSE 417: Advanced Biomaterials (6)
(O15) MSE 418: Tissue Engineering (6)
(O16) MSE 470: Fusion and Advanced Reactors (6)
(O17) ME4-MNUTH Nuclear thermal Hydraulics
(O18) ME4-MNURP Nuclear Reactor Physics
(O19) CE4-30 Nuclear Chemical Engineering

As part of The Art of Research course you will attend research seminars (producing reports on three of them), an ethics course, and transferable skills seminars offered by the graduate school. You will meet regularly with your project supervisor in the autumn term to discuss your project and to write your project proposal. A full time independent research project will run from the end of the exam period beginning of September. Projects will be assessed by a final written report and oral presentation.
ECTS summary

Core modules = 12 ECTS
Research modules (R1 and R2) = 11 ECTS
5 x Option = 30 ECTS
Research Project = 37 ECTS
Total = 90 ECTS

3.1 Thematic Strands
To support coherent course choices that work together and promote learning of more specific aspects of materials the course options are grouped into themes, as outlined below:

Compulsory courses
These courses must be studied by all students regardless of the strand or combination of courses they select.

- Art of Research
- Research Project Plan
- Research Project
- MSE 452 (302) Materials Characterisation
- MSE 467 (317) Materials Modelling

Ceramics and Glasses
- MSE 458 (308) Ceramics and Glasses
- MSE 411 Electroceramics
- MSE 413 Advanced Structural Ceramics

Metals
- MSE 457 (307) Engineering Alloys
- MSE 409 Advanced Engineering Alloys

Polymers and Composites
- MSE 309 Polymers and Composites
- MSE 413 Advanced Structural Ceramics

Functional Materials
- MSE 460 (310) Electronic Structures and Opto-Electronic Properties
- MSE 410 Advanced Thin Film Manufacturing Technologies
- MSE 404: Modelling Materials with Density-Functional Theory

Nanotechnology
- MSE 462 (312) Nanomaterials
- MSE 412 Nanomaterials II
- MSE 410 Advanced Thin Film Manufacturing Technologies

Biomaterials Survey
- MSE 315 Biomaterials
- MSE 417 Advanced Biomaterials
- MSE 418 Advanced Tissue Engineering
Nuclear
- MSE 414 Nuclear Materials
- MSE 470 Fusion and Advanced Reactors
- ME4-MNUTH Nuclear thermal Hydraulics *
- ME4-MNURP Nuclear Reactor Physics *
- CE4-30 Nuclear Chemical Engineering *

*These modules are run by other engineering department not materials

Students who have graduated (on the BEng) already from the Department of Materials are forbidden from repeating courses that they have previously completed.

Imperial College is switching to a new system for managing all student information. One consequence of this is that all modules need to have new codes. This handbook still uses the old codes. The table below allows you to find the new codes (first column) from the old codes (second column).

<table>
<thead>
<tr>
<th>College</th>
<th>Department</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATE97004</td>
<td>MSE.309</td>
<td>Polymers and Composites</td>
</tr>
<tr>
<td>MATE97007</td>
<td>MSE.315</td>
<td>Biomaterials</td>
</tr>
<tr>
<td>MATE97009</td>
<td>MSE.318</td>
<td>Surfaces and Interfaces</td>
</tr>
<tr>
<td>MATE97011</td>
<td>MSE.404</td>
<td>Modelling Materials with Density Functional Theory</td>
</tr>
<tr>
<td>MATE97013</td>
<td>MSE.409</td>
<td>Advanced Engineering Alloys</td>
</tr>
<tr>
<td>MATE97015</td>
<td>MSE.410</td>
<td>Advanced Thin Films Manufacturing</td>
</tr>
<tr>
<td>MATE97017</td>
<td>MSE.411</td>
<td>Electroceramics</td>
</tr>
<tr>
<td>MATE97019</td>
<td>MSE.412</td>
<td>Nanomaterials 2</td>
</tr>
<tr>
<td>MATE97021</td>
<td>MSE.413</td>
<td>Advanced Structural Ceramics</td>
</tr>
<tr>
<td>MATE97023</td>
<td>MSE.414</td>
<td>Nuclear Materials 1</td>
</tr>
<tr>
<td>MATE97025</td>
<td>MSE.417</td>
<td>Advanced Biomaterials</td>
</tr>
<tr>
<td>MATE97027</td>
<td>MSE.418</td>
<td>Advanced Tissue Engineering</td>
</tr>
<tr>
<td>MATE97001</td>
<td>MSE.452 (302)</td>
<td>Materials Characterisation</td>
</tr>
<tr>
<td>MATE97002</td>
<td>MSE.457 (307)</td>
<td>Engineering Alloys</td>
</tr>
<tr>
<td>MATE97003</td>
<td>MSE.458 (308)</td>
<td>Ceramics and Glass</td>
</tr>
<tr>
<td>MATE97005</td>
<td>MSE.460 (310)</td>
<td>Elec Str and Opto Elec Props</td>
</tr>
<tr>
<td>MATE97006</td>
<td>MSE.462 (312)</td>
<td>Nanomaterials I</td>
</tr>
<tr>
<td>MATE97008</td>
<td>MSE.467 (317)</td>
<td>Materials Modelling</td>
</tr>
<tr>
<td>MATE97049</td>
<td>MSE.470</td>
<td>Fusion and Advanced Reactors</td>
</tr>
<tr>
<td>MATE97044</td>
<td>MSE.901</td>
<td>Art of Research</td>
</tr>
<tr>
<td>MATE97045</td>
<td>MSE.902</td>
<td>Advanced Materials Science and Engineering Research Essay</td>
</tr>
<tr>
<td>CENG97031</td>
<td>CE4-30</td>
<td>Nuclear chemical engineering</td>
</tr>
<tr>
<td>MECH97033</td>
<td>ME4-MNUTH</td>
<td>Nuclear thermal hydraulics</td>
</tr>
<tr>
<td>MECH97032</td>
<td>ME4-MNURP</td>
<td>Reactor Physics</td>
</tr>
</tbody>
</table>

3.2 Study Groups
Learning can be greatly enhanced by talking with your fellow students about ideas being taught, and problems being solved for coursework. We are thus assigning you to study groups with about 10 students each. They will be set up once you have selected your options, so that we can put people with similar interests in the same group. Each group will have a representative, chosen by the group, who will help coordinate group activity, and will be a link to the Department for that group.
To help support the groups, twice a term for the 1\textsuperscript{st} two terms, the Department will provide lunch vouchers to the study group reps that can be used at campus food outlets: these are to enable each group to go to lunch together. The study groups reps will need to collect the Lunch vouchers from the MSc Administrator on the Mondays 12noon before the lunch sessions. The timetable lunch sessions are:

![Term 1:
Tuesday 29th October 2019
Tuesday 26th November 2019

Term 2:
Tuesday 4th February 2020
Tuesday 3rd February 2020](image)

3.3 Preparing for the courses: reviewing background material

The courses you take as part of your MSc may assume knowledge that you do not yet have. We thus provide you material to fill any gaps in your existing knowledge, in preparation for the lectures that start in week 3. The assumed knowledge will be what is taught by the Department during the first two years of the undergraduate programme.

We have organised much of the course material from our Years 1 and 2 into convenient learning packages that you can find on Blackboard (2019-2020 Materials General Information, MSc Advanced Materials and Engineering (J2U3T)). Each learning package has a description of the module, a set of notes, example problems, and an old exam paper so you can estimate the level of knowledge expected. Where available, recordings of the lectures have been made available through Panopto. The learning packs will be available throughout your time studying for the MSc: you can refer to them whenever this is needed.

To provide structure to your study, we provide a comprehensive paper taken by our undergraduates in Year 3 that covers material form across Years 1 and 2. Your task is to write down answers to the questions in the exam paper using material found in the learning packs, or books in the library. You will have a short online test at the end of week 2 based on the comprehensive paper.

While much of the study may be done alone, we strongly encourage meeting with your colleagues to discuss what you are doing: that way you can help each other learn. Rooms in the Royal School of Mines that you can use to meet are G.06 and G.10, and possibly G.08. You may also be able to use the study spaces in the library.

Topics covered in Year 1
MSE 101 Maths and computing [not available as it is assumed it has been taught]
MSE 102 Materials Chemistry
MSE 103 Mechanics
MSE 104 Microstructure and Properties of Materials
MSE 105 Materials Physics
MSE 106 Materials Engineering [not available as not a prerequisite]

Topics covered in Year 2
MSE 201 Maths and computing [not available as it is assumed it has been taught]
MSE 202 Materials Chemistry
MSE 203 Mechanical Behaviour
MSE 204 Microstructure
MSE 205 Electronic Properties of Materials
MSE 206 Materials Engineering
3.4 Examination of Compulsory and Optional Courses

The examination of the compulsory and optional courses is solely by written examination with the exception of MSE 452, MSE 457, MSE 404, MSE 410 and MSE 412 which consist of coursework and exam components. MSE 467 is assessed entirely by coursework and a test.

Project

The project is assessed as follows:

- The research project plan contributes 20% of the overall mark
- A final presentation (in late September) accounts for 10% of the overall mark and
- A written research report (submitted in early September) accounts for 70% of the overall mark.

The project supervisor will mark the project plan and a panel of assessors with mark the final report. In addition, supervisors are asked to add notes on the technical aspects of the project, the level of supervision required and any other factors that they feel should be made available to the external examiner. The report's technical marks are calculated as the weighted average of the two marks (following moderation by the course director if needed).

The course consists of two elements:

- Lecture courses (47% of the total course mark), consisting of the components:
  1. Compulsory courses
  2. Optional courses

- Research Project and Courses (53% of the total course mark), consisting of the components:
  1. The Art of Research
  2. Research based teaching
  3. Research Project Plan
  4. Written Research Report
  5. Oral Final Presentation

3.5 Term breakdown

Term one:

- Materials characterisation lectures (MSE 452)
- Choose a project supervisor
- Research Project Plan (more detail on page 28)
- Art of Research (students attend a scientific seminar once a week – e.g. those offered by the Thomas Young Centre and the London Centre for Nanotechnology series).

Term Two:

- Materials modelling (MSE 467)
- Materials characterisation labs (MSE 452)
- Start of Research Project (more detail on page 30)

Term Three:

- Exams early in the term
- Continue with Research Project for the remainder of the term and carry on until mid August. By the start of September the students will have written a dissertation (more detail on page 31), and at the end of September will give a final oral presentation.

The table (page 11) gives you important coursework dates that you should remember. Coursework should always be handed in by 3pm into the coursework box (if it's a hard copy submission) or via Blackboard Learn (if its electronically).
Please note that these dates are **preliminary and may change throughout the year**. The dates below also depend on what options you pick so you may not be doing everything listed below. You will be notified of changes by the MSc Administrator or the Student Office by email.

<table>
<thead>
<tr>
<th>Term</th>
<th>Module</th>
<th>Assignment/Event</th>
<th>Due Date</th>
<th>Format</th>
<th>Feedback/Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn</td>
<td>Project</td>
<td>Choice of project title</td>
<td>Thurs 3rd Oct 2019, 11am</td>
<td>On-line selection</td>
<td>1 week*</td>
</tr>
<tr>
<td></td>
<td>Modules Options</td>
<td>Final Module Options</td>
<td>Tues 8th Oct 2019, 11am</td>
<td>Options forms directly to Mrs Raj Adcock</td>
<td>1 week*</td>
</tr>
<tr>
<td></td>
<td>MSE 452 (302)</td>
<td>XRD Classwork</td>
<td>End of your classwork session</td>
<td>Hardcopy</td>
<td>2 weeks (after all sessions have been held)*</td>
</tr>
<tr>
<td></td>
<td>MSE 410</td>
<td>Lab reports (3 in total)</td>
<td>7 days of your lab, 3pm (depends on your lab group)</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
</tr>
<tr>
<td></td>
<td>MSE 404</td>
<td>Homework problems (7 in total)</td>
<td>Every week after the 1st lecture</td>
<td>Hardcopy</td>
<td>1 week*</td>
</tr>
<tr>
<td></td>
<td>Research Project</td>
<td>Research Project Plan</td>
<td>Tue 10th Dec 2019, 3pm</td>
<td>See page 31 for more detail</td>
<td>2 weeks*</td>
</tr>
<tr>
<td></td>
<td>MSE 457 (307)</td>
<td>Coursework: Class based Assignment</td>
<td>Thurs 12th Dec 2019, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>3 weeks*</td>
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<tr>
<td>Spring</td>
<td>MSE 467 (317)</td>
<td>Problem set 1</td>
<td>Thurs 30th Jan 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
</tr>
<tr>
<td></td>
<td>MSE 452 (302)</td>
<td>Introductory Lab Sessions</td>
<td>Day after your lab session, 3pm (depends on your lab group)</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
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<tr>
<td></td>
<td>MSE 412</td>
<td>Poster exercise: abstract file</td>
<td>Thurs 13th Feb 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
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<tr>
<td></td>
<td>MSE 467 (317)</td>
<td>Problem set 2</td>
<td>Thurs 20th Feb 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
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<tr>
<td></td>
<td>Project</td>
<td>Art of Research</td>
<td>Tue 25th Feb 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
</tr>
<tr>
<td>Term</td>
<td>Module</td>
<td>Assignment/Event</td>
<td>Due Date</td>
<td>Format</td>
<td>Feedback/Marks</td>
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<tr>
<td>Spring</td>
<td>MSE 412</td>
<td>Poster exercise: poster file</td>
<td>Mon 2nd Mar 2020 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>N/A</td>
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<tr>
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<td>MSE 452 (302)</td>
<td>Lab Report</td>
<td>Tue 3rd Mar 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>4 weeks*</td>
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<td></td>
<td>MSE 467 (317)</td>
<td>Problem set 3</td>
<td>Thurs 5th Mar 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
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<tr>
<td>Term</td>
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<td>Term</td>
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<tr>
<td>Summer</td>
<td>MSE 467 (317)</td>
<td>Research Essay</td>
<td>Mon 27th April 2020, 3pm</td>
<td>Electronically via Blackboard Learn</td>
<td>2 weeks*</td>
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<td>Exams</td>
<td>All options</td>
<td>April to June</td>
<td>N/A</td>
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<td>Project (full time)</td>
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<td>June-Sept</td>
<td>N/A</td>
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<td></td>
<td>Research Project</td>
<td>Thesis</td>
<td>Tues 1st Sept 2020, 3pm</td>
<td>See Page 31 for more detail</td>
<td>2.5 weeks*</td>
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<tr>
<td></td>
<td>Research Project</td>
<td>Final Presentation slides</td>
<td>Thurs 17th Sept 2020, 3pm</td>
<td>See Page 31 for more detail</td>
<td>2 weeks*</td>
</tr>
<tr>
<td></td>
<td>Research Project</td>
<td>Oral Final Presentation</td>
<td>21st, 22nd &amp; 23rd Sept 2020 (All Day)</td>
<td>Oral Presentation</td>
<td>2 weeks*</td>
</tr>
<tr>
<td></td>
<td>Exam Boards</td>
<td>Internal Exam Board</td>
<td>Tues 29th Sept 2020</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>External Exam Board</td>
<td>Thurs 1st Oct 2020</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* The above dates do not include the Student Office processing time which can be up to additional 5 working days on top of the estimated feedback/mark timeframe.
4. Start of the Year

4.1 Fresher’s week
The first week of term has a mixture of welcoming talks and very important compulsory presentations about for example safety and proper use of resources. Also you should have some free time in between lectures to join in with some of the events around the university.

4.2 Updating your contact information
Most times we will communicate with you using e-mail, but e-mail is not the perfect communication medium for all messages. It is therefore in your interest to keep us informed of alternative ways of contacting you.

If your phone number(s) and/or address change during the year, remember to update this information on your student e-service account as that is where we will look for your personal information.

4.3 Security passes
Student Cards
All students who need an ID card produced for them during Fresher’s week need to show a stamped registration document or a print out from registering online. ID Office will then take a photo of you, and then you are advised to either wait or collect it from us in the Student Office (during the busy fresher’s week). Please note the ID card can take a few days to be produced. If you register online and upload a suitable photo, your IDs will be prepared in advance of you arriving. Student cards are automatically cancelled at the end of the course.

Security ID card office: Room 151 Sherfield Building
Opening hours: Monday to Friday:
08:30 to 10:30
12:00 to 14:00
15:45 to 16:45

4.4 Official documents
To avoid queues at the Student Hub (throughout the year), you can request certificates via the on-line system (http://www.imperial.ac.uk/student-hub/our-services/). Due to the extremely high volume of requests at registration time, they may take slightly longer. Student Records cannot respond to every e-mail received, so if you do not receive a reply, this does not mean that they did not receive your request.

The following documents can be requested through the on-line system:

- Standard Statement
- Letters for Banks
- Council Tax Certificates
- Police Letter/Statement with Address
- Transcript
- Degree Confirmation Letter

More detail about these letters can be found on the Student Hub page (http://www.imperial.ac.uk/student-hub/our-services/student-records/)
4.5 Effective communication in English

Being able to communicate effectively in English is crucial if you want to be successful at Imperial College. The emphasis in examinations and tests is on testing your mastery of the subject. However, expect to be marked down if you are not able to express yourself fluently in English. This is especially the case later in the MSc when more substantial written work such as the research thesis is assessed.

If you feel you would benefit from further lessons, there is a Centre for Academic English (CfAE) at Imperial which offers: “Free, dedicated support to international MSc students in science, engineering and medicine. Our aim is to help you with your language needs for your academic studies and to help you understand the expectations of postgraduate work. We offer:

- One-to-one tutorials with a dedicated tutor to support you with your course work and provide regular feedback
- Courses and workshops targeting specific academic language and skills”

If you wish to register for General Classes, Pronunciation Classes or Writing a Literature Review classes, you should contact the CfAE office to enquire at english@imperial.ac.uk or visit:

Centre for Academic English
Imperial College London
Room 309, Level 3, Sherfield Building

Classes start in mid-October and run until the end of the spring term, with some also running in the summer. Registration starts towards the end of the first week of term and more information on all these classes is available on MSc part of the CfAE website: http://www3.imperial.ac.uk/academic-english/msc

4.6 Widening your skills base: learning other languages

There are many excellent language courses in the College and below is a brief outline. More can be learnt from a visit to the Centre for Languages, Culture and Communication which is based on the third floor of the Sherfield Building or from http://www.imperial.ac.uk/centre-for-languages-culture-and-communication.

Students who would like to study a language can do so in their spare time if they wish. It is always useful to acquire fluency in another language and they are well taught here. The Centre for Co-Curricular Studies is prepared to mark tests and exams in the normal way for 'non-credit' students so you could use the qualification on your CV if you wanted to. There is also a language laboratory where, once you have registered as a user, you may arrange to study in your spare time.
4.7 First Week Of Term Checklist

The first week can be a little daunting, so here’s a brief checklist to help you out:

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>College registration</td>
<td>If you have not yet registered on-line, you should do so as soon as possible via the online application system. It is not possible to issue you with your College ID card until you have registered.</td>
</tr>
<tr>
<td>Security / ID Card</td>
<td>If you did not upload a photo of yourself before the first day of term when registering, you need to do this within the first week. You will then need to come into the Student Office on a daily basis to see if your card is ready for collection (during the first week only).</td>
</tr>
<tr>
<td>Start using your Imperial email account /usernames and password</td>
<td>You should have been allocated a College username and password before arrival at the department. You can also find out your college email address on your Student e-service account. If you don’t yet have one, please come to the Student Office for further help.</td>
</tr>
<tr>
<td>Health &amp; Safety Guide</td>
<td>Read this document and familiarise yourself with the department’s Health &amp; Safety procedures (<a href="http://www.imperial.ac.uk/engineering/departments/materials/hsdom/">http://www.imperial.ac.uk/engineering/departments/materials/hsdom/</a>). You will also be given a safety talk on your first day (details of which can be found in the fresher’s week timetable).</td>
</tr>
<tr>
<td>Imperial College Union Fresher’s Fair</td>
<td>Attend the Fair on Tuesday 1st October between 11-4pm (when you haven’t got scheduled activity in the department). Stalls will be spread over the campus and a plan will be available on the Student Union website.</td>
</tr>
</tbody>
</table>
5. During the year

5.1 Timetable
You will be able to sign up to receive your own personalised timetable and you can find out more detail on how to set this up at http://www.imperial.ac.uk/timetabling/.

5.2 Reading and responding to e-mails from the College
Please make sure you read your e-mail messages at least three times a week. If you receive an e-mail asking you to contact the Student Office or one of the lecturers, you should respond in a timely manner.

5.3 Attendance
The college has three terms: Autumn, Spring and Summer. You are expected to be available to attend activities in College during term time. Classes at Imperial College run between the hours of 9:00am and 6:00pm except on Wednesdays, when they finish at 12:00noon allowing students to take part in sports and other activities. It is essential that students attend College throughout the term. The term dates for this academic year:

<table>
<thead>
<tr>
<th>Term</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn Term</td>
<td>Monday 30th September 2019 – Friday 13th December 2019</td>
</tr>
<tr>
<td>Spring Term</td>
<td>Monday 6th January 2020 – Friday 20th March 2020</td>
</tr>
<tr>
<td>Summer Term</td>
<td>Monday 27th April 2020 - Friday 26th June 2020</td>
</tr>
</tbody>
</table>

(Please note as MSc students your summer term ends at the end of September)

Note that the term dates only refer to the calendar of lectures and the taught element. Your research component will require you to attend College outside term after the Summer Term. You are expected to attend all lectures, tutorials and any practical classes; they are interdependent and together they form the basis for all the knowledge you will build on during your studies. We attach great importance to attendance by our students in the Department of Materials at your level of study. Therefore, if for any reason you are unable to come in to College, you must contact the MSc Administrator at the start of the day by telephone or e-mail. You will also need to provide the MSc Administrator with a medical certificate if you are away for more than seven consecutive days, or immediately if you are missing an in-course test or examination. **It is important to note that lectures are conducted on the last day of each term so you should not arrange travel until after that date and make sure to return for the start of term.**

5.4 Use of Departmental and College Facilities
For private study, students are allowed to be in the Department between the hours of 8:00am - 6:00pm only. If you need access out outside of these hours then you will have to request for permission and please note it is not normally given to students for safety reasons. You will need to use your swipe card to get in and out of the department outside the normal College hours, and will be asked to sign a book so that the security officer knows where you are in any emergency – if the fire brigade does not know you are in the building they will not come looking for you. Your swipe card is only effective at the RSM entrance and the Bessemer Building entrance. **No experimental work is allowed unless the student is accompanied by a qualified person to supervise.**

Computing rooms
You have access to the student computing room (G.08) apart from the times when a class is being held there, and can print your documents there. You should not misuse the departmental computers, nor use them to play games.
Many students need the computers to complete coursework using software only available on these computers and selfish behaviour is not tolerated. You will find further computing facilities in the library. You can use lecture rooms as your study room when lectures/tutorials are not being given there but you must check with the Student Office first.

**Departmental Common Rooms**

You have access to two common rooms: G06 and G10. G06 is accessible to all Undergraduate and MSc Students. G10 is only accessible to MSc Student and 3/4th year undergraduate students. These rooms are for you to study in, in both groups and individually. You should not misuse the departmental rooms and be respectful of other students when using the room. This room is for Materials student **ONLY**, do not let in any other authorised students in the room. Any misbehaviour will **not be tolerated**.

**Post**

Any post received for you, internal and external, will be placed in the pigeonholes which you can find in **room G10 mezzanine floor** and you should check as often as possible, and take anything addressed to you. The College address should only be used for course related post and **not personal post**. Please remember that there is not much room and accumulated post causes problems so it will only remain there for a limited time.

**Photocopying and printing**

Your swipe cards will have an amount of credit loaded on to it at the beginning of the term for use with the photocopiers in the computer rooms. You can use any printer/photocopier across the campus that is for student use with your swipe card. If you run out of credit then there is a top up machine in the central library. Please use the pre-loaded credit wisely as the department will not top it up for you.

**The Library**

The Imperial College Central Library and the Science Museum Library share a building at the heart of the South Kensington campus, near the Queen’s Lawn.

The Central Library has information on all subjects taught by the College, although it specialises in undergraduate, interdisciplinary and electronic material. There are a number of specialist collections, including a Core Text section, the Haldane Collection which contains humanities material, recreational reading, newspapers and magazines, and a music collection with tapes and CDs. The Science Museum Library specialises in the history of science and technology and the public understanding of science.

Access to the Central Library is 24hrs, except every Friday 23:00—Saturday 10:00 is closed. (please note this changes throughout term so you can find more detail at [http://www.imperial.ac.uk/admin-services/library/use-the-library/our-libraries/central-library/](http://www.imperial.ac.uk/admin-services/library/use-the-library/our-libraries/central-library/)

**5.5 Coursework**

You will be asked to write various pieces of coursework marked by your project supervisor or lecturer/demonstrator. Most coursework must be submitted electronically via Blackboard. Hardcopy coursework must be submitted in the coursework box (outside the Student Office). All coursework must be submitted before the deadline. We recommend submitting 24 hours before the deadline in case there are problems. You should definitely leave at least one hour. For all reports the **deadline for submission of your work is 3pm** of the stipulated deadline date.

Work submitted to the Student Office will be stamped with the date and time of receipt while Blackboard will keep a record of the submission time of all work submitted electronically. Late receipt of work may be penalised. During ‘out of hours’ time, work can be ‘posted’ in the red letterbox (or the sliver slot below) outside door to G.03a and will be stamped as received on the following day. Where the deadline falls outside the term dates, it is replaced by the first Monday of the next term.
When submitting any coursework, please ensure you provide all of the information required:

- Full Name (registered name)
- CID Number
- Title subject of coursework you are submitting
- Course Programme

We can’t allocate you marks, if we don’t know who you are! So its very important the above information is inputted on the front of any coursework submitted.

**Late work:**
Work submitted up to one (1) day after the assessment deadline (date and time) will be marked but capped at the pass mark. Work submitted more than one (1) day late will not be accepted as a valid attempt and mark of zero will be recorded. However, the work may still be marked so you get your feedback.

<table>
<thead>
<tr>
<th>Days/Hours late</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (up to 24 hours after the assessment deadline)</td>
<td>Capped at the pass mark</td>
</tr>
<tr>
<td>2 (more than 24 hours after the assessment deadline)</td>
<td>Mark of zero awarded</td>
</tr>
</tbody>
</table>

**Marking:**
Once the coursework has been marked and the mark recorded will be returned to you via Blackboard Learn by the Student Office. The mark scheme set out below:

<table>
<thead>
<tr>
<th>A*</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>85%-100%</td>
<td>84-70%</td>
<td>69-60%</td>
<td>59-50%</td>
<td>49-40%</td>
<td>39-0%</td>
</tr>
<tr>
<td>Distinction</td>
<td>Distinction</td>
<td>Merit</td>
<td>Pass</td>
<td>Fail</td>
<td>Fail</td>
</tr>
</tbody>
</table>

Please note that not handing coursework in on time and a lack of quality in your work are considered as strong indicators of a lack of academic progression. Failure to complete coursework could seriously affect your chances of remaining on the course.

**5.6 Mitigation Forms/Illness**
If due to illness or other serious circumstances you foresee that you will not be able to complete a piece of coursework by the deadline, you may be granted an extension provided you apply for it before the deadline. However, this will not be possible to do without a completing a minor/major mitigation form with evidence to support your claims. You can find these forms on Blackboard Learn, and they must be completed within 10 working days of the deadline, together with corroborating evidence. However, cases which cannot be resolved will then get referred to the mitigation advisory panel for a decision (which is before the exam board in late September).

In case of illness, you must inform the MSc Administrator of your absence. Please give the dates of absence and the reason(s) for the absence. If the period of absence exceeds five working days, then you also need to inform the MSc Senior Tutor and provide evidence of the reasons for the absence, for example, a doctor’s note. If you are experiencing other serious difficulties, you are advised to discuss this with the MSc Senior Tutor and Course Director.
5.7 Plagiarism

You are reminded that all work submitted, as part of the requirements for an examination at Imperial College must be expressed in your own words and incorporate your own ideas and judgements.

Plagiarism, that is the presentation of the thoughts or words of another person as though they were your own, is not acceptable. Particular care should be taken in coursework, essays and reports written in your own time. Note that you are encouraged to read and criticise the work of others as much as possible. You are expected to incorporate this in your thinking and in your coursework and assessments but you must acknowledge and label your sources. Direct quotations from the published or unpublished work of others, from the Internet or any other source, must always be clearly identified as such. Remember that a series of short quotations from several different sources, if not clearly identified as such, constitutes plagiarism, as does an unacknowledged long quotation from a single source. Equally, if you summarise another person’s ideas, judgements, figures, diagrams or software, you must refer to that person in your text, and include the work referred to in your bibliography.

You should consult your Senior Tutor, if you are in any doubt about what is permissible. Direct and unacknowledged repetition of your own work, which has already been submitted for assessment, can constitute self-plagiarism.

You should be aware that you have a collective responsibility for the integrity of any group work submitted for assessment. The use of the work of another student, past or present, constitutes plagiarism. Where work is used without the consent of that student, it will normally be regarded as a major offence of plagiarism. **Failure to observe any of these rules may result in an allegation of cheating.**

Cases of suspected plagiarism will be dealt with under the College’s Procedure for Dealing with Examination Offences and may result in a severe penalty being incurred by any student found guilty of plagiarism and could ultimately lead to you being told to leave the College.

We ask all markers to be attentive for plagiarism and randomly select coursework to process through a plagiarism detection website. Additionally some pieces of course work will be submitted through Blackboard Learn (Turnitin) and this will automatically carry out a plagiarism check.

You will do an online plagiarism awareness course during Fresher’s week to ensure that you have grasped all the concepts relating to good practice (see section 11.2).

5.8 Satisfactory progression during the year

During the year the Course Director will receive information on your progress of completed course work or examination results at intervals throughout the year, and will discuss these with you (if necessary).

Students who are deemed not to progress satisfactorily can be excluded from examinations; a procedure of which any funding source would be kept informed. Ultimately, the student may be put on a six weeks’ notice, and if there is no improvement in performance this ultimately may result in withdrawal from the course.

5.9 Getting help

As a postgraduate university student you are deemed to be an adult capable of making your own decisions. The downside of this is that you are also responsible for your own decisions and that you will have to suffer the consequences for any poor choices you make.

Promising that you will work much harder next time round or pleading that you are a better student than the exam results show will not influence any decision by the Board of Examiners. However, part of being a mature student is recognising that sometimes you need help or advice.
To help you make that transition towards being able to manage your own life a range of people are available for you to seek help or advice from.

The reason for seeking help sooner rather than later is quite simple: evidence of circumstances which have affected your performance are considered when making decisions about your progression. But with so many students with difficulties in their life who have gone before you and have performed exceptionally despite their difficulties, it is rare for a case to be strong enough to alter the decision.

You should therefore assume that as a rule, whatever your circumstances, once a test or exam has been taken, the result will stand. Before the test or examination we can advise you what the regulations allow us to do for you or where you can find the most effective help.

Nobody can monitor how well you are doing better than you. **If you are worried, seek help immediately.**

**Your MSc Senior Tutor**

Your Senior Tutor acts as your personal tutor (if required) and will remain the same person throughout your time here at the Department. They would be the first point of contact if you need help or guidance along side the MSc Administrator.

Your Senior Tutor will therefore get to know you better than most other members of staff and is best placed to advise you on study skills, progression, and professional development. You can talk to your Senior Tutor in confidence on any matter that is affecting you. Your Senior Tutor can speak on your behalf at the meeting of the Examiners should that be required, but can only act on information you have made available.

Senior Tutor Office hours: Everyday 1:30-2pm (drop in sessions)

**Your Course Director**

Your Course Director also acts as your personal tutor, if the Senior Tutor is not available (if required). They can be contacted about course matters that you think need to be raised and addressed.

Your Course Director is also well placed to advise you on study skills, progression, and professional development. You can talk to your Course Director in confidence on any matter that is affecting you. Your Course Director can speak on your behalf at the meeting of the Examiners should that be required, but can only act on information you have made available.

In addition of this you will also have two Class Representatives who you can raise any concerns on your behalf to both Senior Tutor/Course Director (more information on page 23).
The Materials Student Office team

Emails: queries etc.
Please note that when emailing the MSc Administrator/Student Office we aim to respond to your queries in a timely manner (within in 3 working days). However this is not always possible in busy periods of the term so it can take longer, please keep this in mind. **Do not resend emails or come into the office to ask us to respond to your email.** We will always try our best to respond to urgent queries as soon as possible and other email when we can.

Letter request
If you need the Student Office to provide you with a letter, please give the MSc Administrator at **least a week’s notice** (more if possible). At busy times in the term it can take up to **2 weeks** for a request like this to be done. So ensure you keep this in mind and ensure you provide all the information you need in the letter by email.

If you require a reference Letter or a signature of the Course Director, please could you email and discuss this in advance of your need with them directly.

Student Office Hours

The Student Office is in G.03a and is open to students from:

- Monday 8:45am-4:15pm
- Tuesday 8:45am-4:15pm
- Wednesday 8:45am-2:00pm
- Thursday 8:45am-4:15pm
- Friday 8:45am-4:15pm

There will almost always be someone there to help you if you need it and your first point of contact is the MSc Administrator, Mrs Raj Adcock (or the other staff in the Student Office when the MSc Administrator is not there). However there may be times when the office is not open during the term due to staff meetings etc. so please keep this in mind.
Support offered outside the Department

Life can throw up all kinds of challenges. For many issues, there are practical steps you can take to deal with them, and there is lots of support available to help you do just that (http://www.imperial.ac.uk/student-space/support/) Below are listed some of the main areas you may need support.

The Student Counselling and Mental Health Advice Service:
Level 4, Sherfield Building, Room 449
Telephone: 020 7594 9637   Email: counselling@imperial.ac.uk
http://www.imperial.ac.uk/counselling/

International office
Room 301, 3rd Floor, Sherfield Building,
Telephone: 020 7594 8040   Email: international@imperial.ac.uk;
http://www.imperial.ac.uk/study/international-students/

The Health Centre:
Imperial College Health Centre, 40 Princes Gardens, London SW7 1LY
Telephone: 020 7584 6301 or 020 7594 9375/6
http://www.imperialcollegehealthcentre.co.uk/

National Health Dental Service:
Prince’s Garden, South Kensington Campus
Telephone: 020 7589 6623
New patients are welcome. You can register Monday to Friday 09:00 — 17:00.
http://imperialcollegedental.co.uk/

Disabilities Office:
Level 5, Room 566, Sherfield Building,
Telephone: 020 759 49755
Email: disabilities@imperial.ac.uk
Departmental Liaison: Prof Alexandra Porter
Email: a.porter@imperial.ac.uk

Imperial College Union Advice service:
The Advice Centreis located in the Union Offices in the Beit Building (telephone +44 20 7594 8060). They provide free and confidential advice on the following areas:
- Academic appeals
- Housing
- Employment
- International student issues
- Consumer rights
- Complaints
- Personal safety

The Advice Service has a comprehensive range of free leaflets on a wide variety of issues and offers a referral system to organisation in the community that students may use. The Advice service operates on an appointment and drop-in basis. You can also e-mail advice@imperial.ac.uk or telephone between 09:30 – 17:00 hours, Monday to Friday.

You can also refer to the Student Support Zone website http://www.imperial.ac.uk/student-support-zone.
College chaplains:
The Chaplaincy Centre, Beit Quadrangle  http://www.imperial.ac.uk/chaplaincy
Tel: +44 (0)20 7594 9600   Email: chaplaincy@imperial.ac.uk

In an emergency you can call the Nightline, 020 7631 0101 for confidential listening and practical information, every night of term, from 6pm - 8am. It is also now possible to contact Nightline via e-mail: listening@london-nightline.org.uk

Imperial College Careers service:
The Careers Service provides professional, impartial and confidential advice to all Imperial College students in the areas of further study, employment and training. Appointments are available to book through the website http://www.imperial.ac.uk/careers/services/ or call +44 (0)20 7594 8024. Appointments are subject to availability.

Careers advice is also available from your Departmental Careers Adviser, Dr Minh-Son Pham son.pham@imperial.ac.uk. Please note you will need to make an appointment or you can talk to your Course director.

Careers website - An up to date site containing information on graduate recruitment events, vacancies, vacation work, library books, links to employers and professional associations. http://www.imperial.ac.uk/careers/services/events/.

Vacancies - JobsLive is the Careers Service's online system for booking events and appointments, searching for jobs and employers. Current Imperial students are automatically registered with JobsLive, just use your Imperial username/password to login, https://imperial.targetconnect.net/home.html.

6. Security and safety

Security
We have been asked by the College Security to point out to all students the importance of looking after your own property. It is an unfortunate fact that the petty theft rate is relatively high in all Universities and Colleges and while we do our best to ensure that it is kept to a minimum it is up to you to make sure that you are constantly vigilant.

- Do not leave bags unattended in corridors or anywhere else.
- Do not bring valuable objects into College without good reason: if you must, then keep them safe, preferably by keeping them with you.
- If you have access to rooms, which are normally kept locked, then do lock the door when you leave.

Safety
Please familiarise yourself with the Departmental Safety Policy and important useful safety personnel in the department which you can find on our website: http://www.imperial.ac.uk/engineering/departments/materials/hsdom/

Departmental Safety Officer:
Dr Peter Petrov
Room B333 (LCN Corridor)
Contact Tel: 48156 or 50321
Email: p.petrov@imperial.ac.uk
7. Tell us what you think

You should not be afraid to ask questions about the lectures or indeed to suggest ways in which the lectures could work better for you. However, keep in mind that what would be optimal for you might not be for your fellow students and that each lecturer will try to find a balance for the class which also suits their style of teaching.

Your feedback is important to your department, the College and Imperial College Union. Whilst there are a variety of ways to give your feedback on your Imperial experience, the following College-wide surveys give you regular opportunities to make your voice heard:

- PG SOLE lecturer/module Survey or departmental equivalent
- Postgraduate Taught Experience Survey (PTES)
- Student Experience Survey (SES)

The PG SOLE runs at the end of the autumn and spring term(s) This survey is your chance to tell us about the modules you have attended and the lecturers who taught them.

For PG SOLE your lecturers will receive their individual numerical results and comments shortly after the survey closes. To make the most of your opportunity to give your feedback, please do not use offensive language or make personal, discriminatory or abusive remarks as these may cause offence and may be removed from the results. Whilst this survey is anonymous, please avoid self-identification by referring to personal or other identifying information in your free text comments.

The Postgraduate Taught Experience Survey (PTES) is the only national survey of Master’s level (MSc, MRes, MBA and MPH) students we take part in. This is the only way for us to compare how we are doing against the national average and to make changes that will improve our Master’s students’ experience in future. PTES covers topics such as motivations for taking the programme, depth of learning, organisation, dissertation and professional development.

The Student Experience Survey (SES) is another opportunity to leave your views on your experience. This survey will cover your induction, welfare, pastoral and support services experience.

All these surveys are anonymous and the more students that take part the more representative the results so please take a few minutes to give your views.

Year representatives and the staff-student committee

At the start of the academic year, you will elect two Class Representatives. They act as the focal point for Departmental – Student Cohort interactions, sitting on the Department’s Student Student-Staff Committee and the Post Graduate Committee and providing representation (together with other Class Representatives) across the college, typically via the Imperial College Student Union. The Departmental Teaching Committee is normally scheduled shortly after these meetings to ensure that we can discuss how, as a Department, we can best address any concerns raised.

Each cohort will select students to represent them on the committee. Help your representatives to be effective by telling them what you think so that they can report back to us what the year as a whole is thinking at the staff-student committee.
8. Examinations

8.1 Preparing yourself

Preparing for exams starts on the first day of the first term. The format of University exams is such that you are unlikely to achieve results which reflect your potential fully if you only start studying close to the exams. There is only limited time available for revision and you must make sure that you can use that time to re-visit the material to remind you of the understanding you have acquired during the year. You will need to do the following:

- Gather together, read, and understand all the lecture notes, class-work and worked solutions.
- Try past papers – papers for the last 2 years are available on Blackboard Learn (where possible).
- Know what is going to be covered in the exam and the format of the examination paper.
- Know when and where the exam will take place.
- Be familiar with the use of the examination calculator. In all college examinations you will have to use the standard calculators supplied by the Department because you will not be allowed to use your own calculator. If you want to get accustomed to using this calculator before the exams you can arrange to borrow one from the Student Office for a short period.
- If you are registered dyslexic you should inform the MSc Administrator as soon after registration as possible. It is possible to receive certain concessions in examinations, e.g. extra time, use of a spellchecker, but this is only possible when a student has registered with the Disabilities Office.

8.2 Just before the start of the exam

- Be in plenty of time for the exam, allowing for public transport etc. if necessary. You will be allowed into the exam room about ten minutes before the start of the exam. All personal belongings should be left at the front of the classroom.
- Be absolutely sure you have NO revision notes on your person when you take your seat. You risk disqualification if you forget this. There will be a seating plan with your candidate number on a desk in the exam room: find it and sit down in the appropriate seat. Do not look at the exam paper until you are told to do so by the administrator/invigilator.
- If you are too unwell to sit an exam you must consult a doctor on the day of the exam and obtain a letter from him/her stating that you were not well enough to sit an exam. It is essential that you inform the MSc Administrator immediately and before the start of the exam.

8.3 During the exam

- At the start of the exam there will be a number of members of staff present. You will be told when you can start the paper and when you must stop writing.
- Staff will act as invigilators and will supervise the exam and patrol the examination room from time to time. Several different members of staff may share the invigilation duties during the exam.
- Read the instructions for the exam carefully and make sure you are aware of what you are required to do. If any errors are found in the exam paper the invigilator will inform you and corrections will be written on the whiteboard at the front of the class.
- You may leave the exam permanently at any time from thirty minutes after the start of the exam. You may not leave the exam in the last thirty minutes of the allotted time as this may cause a disturbance to other candidates. Once you have left the exam room you will not be able to go back (but see below).
- On the front of every answer book write your candidate number clearly. Never write your name on your answer books.
• If you have a query or require extra answer books raise your hand and the invigilator will come to you. NEVER leave your seat without permission.

• You may leave the lecture theatre under supervision to use the toilet. Again you should inform the invigilator by raising your hand and he/she will then escort you to the nearest toilet.

• If you have attempted more questions than is required, delete clearly the questions you do not wish to be marked. You should not hand in any rough work. On the front of the first answer booklet write the numbers of the questions that you have attempted.

• Do not leave your seat until you have been told that you may do so even after the exam has finished.

8.4 Good examination technique

• Always read the exam questions carefully - it is time very well spent. It is amazing how often the candidate provides an answer, which is not what the question requires. The most common reason is that the candidate starts reading the question and finds it similar to a class work problem previously attempted. The candidate then skims quickly over the rest of the question and starts providing the answer for the class work problem with which he/she is familiar, although the exam question requires a significantly different answer.

• Always attempt the full number of questions required. For example, if the exam requires you to answer three questions it is better to attempt three questions than to spend all your time attempting to answer two questions perfectly. This is because, in general, it is relatively easy to obtain the first 55-65% of the marks for a question but it becomes increasingly more difficult to obtain the remaining marks.

• The questions asked in an exam are straightforward - there are no tricks! Remember the questions are set so that a student should be able to gain full marks in the limited time available for each question in the exam. From the time available for each question you should be able to estimate the correct amount of time to spend on each part of that question. This in turn will guide you concerning the amount of detail expected in, for example, the answer to a descriptive part or a derivation.

• If you finish the questions in less than the time allocated, spend the remaining time checking your work. Check the arithmetic and, in the case of more qualitative questions, think about your lecture notes/lab class reports again - you might come up with more relevant facts, which escaped your memory during your first attempt at the question.

• If you make an error in the arithmetic/maths in your answer, don’t panic. You will lose a few marks for the error but most of the marks are given for the method.

8.5 After the exam

After the exam the exam scripts are marked by the examiners and then second marked by another member of staff. This process can take several weeks so you will not receive any feedback immediately. Exam results are not official until they have been considered by the External Examiners (a chosen academic from another university or suitably qualified person from a relevant industrial background) and there has been an examiners meeting (this takes place at the end of the course usually end of September).

This is also true for coursework. After this has taken place you can download all your marks from your Student E-service (exams and coursework).

In the unlikely event that you are unable to sit an exam through serious medical reasons you may be able to take the exam (if this is agreed by the exam board). Please note for MSc courses this is the following summer, you are not permitted to sit the exam any other time.
Re-sits:
You may find out that you have to take some re-sits (after the exam board at the end of September) in order to pass the degree program. Please note the Departmental Policy on re-sitting exams is that they are ONLY allowed to be taken in the Department we do not allow them to take place aboard. You have to re-sit your exams within two years of your study here; failure to do this will result in you being withdrawn from the course.

Re-sit Timetable
If you are required to re-sit then please note the Exam timetable will not be published until Spring term and you will receive a email from the MSc Administrator in March with details for the re-sits your are doing.

Marking Schemes for postgraduate taught programmes:
The pass mark for all postgraduate taught course modules is 50%. Students must pass all elements in order to be awarded a degree.

9. Departmental policy of failures

9.1 General policy
The Materials Department does not offer students the opportunity to repeat if you are deemed to have failed unless medical or personal problems are known to have had a severely adverse effect on their studies during the relevant academic year. Before the examination period all students are invited to provide the MSc Administrator with any relevant information concerning mitigating circumstances.

9.2 Marginal exam failures
Students who fail examinations by a small margin may be allowed to pass at the discretion of the exam board. No failures below 40%, however, can be considered.

9.3 Other examination failures
Students who fail examinations by a significant margin are required to withdraw from the College, but with the right to return to take the examinations for the failed modules again the following year in the summer, provided always that they have achieved a satisfactory mark in the Research Project and Taught Elements (>50% in the project, but also enough marks for the taught element to get 50% after doing the re-sits).

9.4 Coursework failures
There is a requirement that our students achieve a sufficiently high overall mark in coursework in order to pass the MSc. All students are made well aware of (i) the importance of coursework and the need to achieve an aggregate mark of 50% of the total coursework mark; and (ii) the individual marks carried by coursework in each subject. They are encouraged to monitor their own progress as each piece of graded work marks are uploaded on Blackboard Learn.

There are deadlines for the submission of each piece of coursework, with penalties for late submission as stated before. If any student cannot carry out practical work at a scheduled time or submit a report by a particular deadline because of a medical or personal problem, then alternative arrangements can be made if the MSc Administrator is informed.

Given the above, and in the absence of any convincing extenuating circumstances, the Materials Department does not offer students who have failed research project element to either pass or repeat the year. They are required to withdraw from the College permanently.
9.5 Overall performance
In addition to these criteria, students also have to achieve a sufficiently high overall mark for the year to pass (combined exams/coursework and project). These two components are known as the elements of the MSc. For any Masters course you must achieve at least 50% in each element of the MSc. Likewise to achieve a Merit you must achieve 60% in each element and for a Distinction a mark of 70% for each element.

10. Research Project
You will learn what your project will be in week 3 of the Autumn Term. You can start on the project plan immediately after you have spoken with your supervisor. The plan must be submitted for assessment by the end of the Autumn Term. The research is mostly carried out once you have finished your exams, after which you need to write it up as a thesis (submitted in early September), and present a talk about it to the other MSc students and some academics (end of September).

Research Project Plan
During the Autumn Term you will need to write a project proposal. This gives the information you need to plan the project in advance, and to enable the Department to assess the suitability of the project.

Below is the format of the project proposal with a description of the information requested. Note that preparation of the proposal will require reading and understanding of the literature, as well as an appreciation of what the project will aim to achieve. The deadline for this assignment is **Tuesday 10th December 2019, 3pm**.

**Track Record [No marks]**
One paragraph describing what your UG degree covered.
- Note any previous research work you have done
- Note any experimental equipment you have learned to use
- Note any computational methods you have learned to use

**Project Summary [85 marks] [approx. 4 pages]**
**Background [40]**
- Introduce the project topic and explain its context
- Review the state of scientific understanding in the field
- Describe the gap in our knowledge that the work will address

**Research hypothesis and objectives [20]**
- Set out your research idea or hypothesis
- Identify the overall aims of the project

**Programme and methodology [25]**
- Describe your research methodology
- Describe the work programme, indicating what research is to be undertaken, and the order in which the work will be done

**Research Impact [5 marks]**
One paragraph to describe how your research may be of benefit to society and the state of scientific knowledge.

**Work plan [5 marks]**
Provide a diagrammatic work plan (Gantt chart).

**Resources Needed [No marks]**
List the resources you will require, and what equipment training you will need. Indicate what assistance you will require from other people. Indicate how you will use the £500 allocated to your project by the department. Please confirm this with your supervisor.
References [5 marks]
Provide a list of your references here; around 20 would be typical.

This project proposal can be up to six A4 sides, including references. The minimum allowed font size is 11pt, the minimum margin width is 1.5 cm, and the minimum line spacing is single spaced.

Some other things to remember when submitting:
- Electronic copy submitted through Blackboard Learn (for marking)
- Electronic copy submitted through TurnItIn (plagiarism check)
- Style of font is Calibri or Arial (or similar)
- A4 size

For the references you can either use a numerical scheme:


or the Harvard scheme (recommended if you are not using reference management software):


Art of Research/Research Based Teaching (all year)
This module is compulsory and includes a minimum of three elements:

- Regular attendance at research seminars. You need to write summaries on 3 research seminars of your choice. The summary should be one A4 page (approx. 500 words). It should give the general background and key conclusions of the talk, and also your personal perspective on the research presented. The deadline for this is Tuesday 25th February 2020, 3pm (this is to be submitted as one document). However, I suggest you do a summary as soon as you hear a talk that inspires you. You will start to receive emails about LCN seminars, there will be a lot of these throughout the year and other talks too. Be proactive about getting information on more specialised talks from our research groups when you are assigned a supervisor.
- Attendance at a course on Research Ethics, to be scheduled in term 2.
- Attendance at the compulsory course ‘Writing for Masters 2: Literature Review’ which is timetable in the department in week 2
- Attendance at one other course from the graduate school (see link: https://www.imperial.ac.uk/study/pg/graduate-school/students/masters/professional-development/).
- Please try to get this done in Term 1 and then you can use the skills you have learnt for your research and study.
Lab Equipment
We will provide opportunity for training on some shared equipment that you might need to use in the context of your research project. Please discuss with your research supervisor whether this training is required as they will **need to formally approve your registration**. This can be discussed during the project planning. We will not allow training if justification is not given.

Note that your access to the equipment is subject to availability so please make sure you plan your experiments carefully and be respectful of everybody’s needs on the equipment. Think carefully whether the time on a highly specialised equipment is really required, or if you could get the answers another way, and prioritise your key samples. Please note that any misuse of equipment can lead to your access being revoked.

Lab-work
Please note that safety is our number one priority. If you need to use labs, make sure you use the facilities responsibly and abide by the College, departmental and local safety rules. The compulsory safety lecture by Peter Petrov will provide you with the information you need to work safely, and should be referred to throughout the year.

**Failure to abide by the safety rules will be penalised** and can have consequences for your degree classification or even result in expulsion from the course.

We want you to experience our excellent research environment to carry out your project, but can only do so if the safety rules are followed. In particular, please note that access to the labs will only be provided following training and if you have demonstrated that you can work safely and responsibly. Access is left at the discretion of the Laboratory Operations Manager(s) and can be revoked at any time. You are also not allowed in the labs outside of College working hours, Monday-Friday, 8am-6pm and should not work on your own.

This still leaves plenty of time for experiments especially as you will need time to plot and interpret your results, and to refresh your knowledge of the literature. Therefore, a **healthy balance of lab-work (or simulations in the case of theory-based project), planning, analysis and writing up is key to a successful project**.

You should therefore aim to **finish your lab-work (or simulations) two weeks before the project submission deadline**.
**Thesis (Research Project)**

The thesis should answer the research question and convey the ability to develop an appropriate methodology to solve the problems posed. A high level of scientific understanding is expected. This includes an awareness of the scope and limitations of the techniques used, an ability to present and interpret results, the discussion of the results in light of the wider literature, and an understanding of the wider implications of the findings.

The layout should be discussed with the supervisor, but the recommended general outline is as follows:

- **Abstract**
- **Introduction**: brief overview of the background, statement of the aims, overview of the thesis layout.
- **Literature review**: This must not be a copy of what you wrote for the project proposal, but rather a review of the literature relevant to the project; it will generally be rather more extensive than what was done for the proposal.
- **Experimental/Materials and methods**: brief overview of the techniques used and methods adopted or developed. The information should be sufficient to allow the work to be reproduced by someone else.
- **Results and discussion**: impeccably plotted graphs and annotated figures with helpful captions are expected. The results should be thoroughly described, with a clear narrative justifying the methods adopted and linking the findings to the aims. Discussions should go beyond simple description and be supported by general and specialised scientific concepts and literature.
- **Conclusions and future work**: a summary of the results and their implications in the field, as well as suggestions for key future work.
- **References**: the style should be consistent.
- **Appendix**: This is optional but this will not be marked.

Writing concisely is a skill that you should be developing throughout the degree. It is easier to write a high quality short document than a long one, and this is easier to mark in a robust fashion. Therefore the project report is limited to **40 pages in length** (excluding any appendices for the supervisor, etc) – a total of 20 sides of A4, including cover sheet and references.

A template (in LaTeX and MSWord) is provided on Blackboard learn and should be respected – **11pt Arial/Calibri for the main text, with 1.5cm margins, single spaced. Pages should be numbered, with the cover page being page**.

Further guidance is provided in the templates provided and the marking rubrics on Blackboard learn.

**Some other things to remember when submitting your thesis:**

- Electronic copy submitted through Blackboard Learn (for marking)
- Electronic copy submitted through TurnItIn (plagiarism check)
- Thesis Declaration (find this on Blackboard Learn)

Deadline for your Thesis is **Tuesday 1st September 2020, 3pm**.

**Research Project: Final Presentation**

You will need to give a PowerPoint presentation that summarizes your research project. You have a total of 15 minutes: 12 minutes for the talk plus 3 minutes for questions. Your presentation should:
1. Introduce the aims of the project and situate it in the context of the research literature
2. Show the main results and findings
3. Discuss those results and present your conclusions.

You need to express yourself confidently when discussing the work and answering questions. The presentation should have a logical structure and high quality slides, figures and graphs.

Deadline for submitting your presentation slides **Thursday 17th September 2020, 3pm.**

The following links are reminder of what is expected from you and your supervisor during your project:

**What master’s students and their project supervisors might mutually expect from each other (MSc, MEd, MPH, MRes & PG Dip)** – this document is intended to facilitate conversations between project supervisors and their students to establish effective partnerships.

The document can be found in the **Effective Partnerships** section of the Graduate School’s Supervisors’ Guide website.

**Roles and responsibilities of the Master's Main Project Supervisor** - this document is intended to help clarify expectations as well as giving better definition to the role of project supervisor.

The document can be found on the **Roles & Responsibilities** page of Registry’s Quality Assurance & Enhancement website.

Please refer to them thought out your projects for reference.

**11. The Graduate School**

The Imperial College Graduate School supports the learning experience of postgraduate studies on taught and research degrees. As soon as you begin your postgraduate studies at Imperial College you automatically become a member of the Graduate School. Membership means you become part of a wider community, broadening and enriching your academic experience. Their remit includes both quality assurance and the provision of the award-winning and internationally renowned programme of transferable skills training.

As part of the Graduate School, the Postgraduate Development Unit (PDU) ensures that the transferable skills programme is educationally relevant, develops new initiatives and ensures its quality and relevance. All activity undertaken by the PDU is underpinned by an educational research programme, specifically focused on the postgraduate student experience.

The Graduate School is also responsible for the regular review of Master’s Level Courses and Research programmes, ensuring best practice across the College.

They also organise a number of special events throughout the year which are designed to bring all postgraduate students together in an informal setting and to foster interdisciplinary discussion – as an MSc student we encourage you to participate in such events and to make use of the many opportunities Graduate School membership offers.

Full information is at: [http://www3.imperial.ac.uk/graduateschools](http://www3.imperial.ac.uk/graduateschools) (please see Appendix B for a welcome letter form the Graduate School)
11.1 MasterClass Programme

Students on Master's level programmes are encouraged to develop transferable skills as an important part of their postgraduate education here at Imperial, and most Master's students will receive transferable skills training as an integral part of their Master's programme.

The Graduate School has developed a MasterClass programme specifically for Master's level students. [http://www.imperial.ac.uk/study/pg/graduate-school/professional-skills/](http://www.imperial.ac.uk/study/pg/graduate-school/professional-skills/)

These sessions have been designed particularly to give you an introduction to each of the topics.

- Academic Writing
- Developing your career through Networking
- Informational Posters - Layout & Design
- Interpersonal Skills
- Interview Skills
- Job search with a difference
- Negotiating Skills
- Note Taking and Efficient Reading
- Preparing and writing a literature review
- Research Skills and Reference Management
- Stress Management

11.2 Plagiarism Awareness

[https://www.imperial.ac.uk/study/pg/graduate-school/students/masters/professional-development/plagiarism-online/](https://www.imperial.ac.uk/study/pg/graduate-school/students/masters/professional-development/plagiarism-online/)

This course was developed by the Graduate School, in conjunction with the Library. It aims to equip all Imperial postgraduate students with a working knowledge of the concept of plagiarism and how to avoid it.

You are required to achieve a threshold level of understanding which will be tested through a final exam. Instructions on how to receive a certificate as proof of completion can be found in the course in the section ‘Course Info.’

On completion of this online workshop you will be able to:

1. **Explain** what plagiarism is
2. **Identify** incorrect referencing and possible potential cases of plagiarism
3. **Apply** techniques to avoid the different types of plagiarism
4. **Reference** properly someone else’s work as well as your own work
5. **Evaluate** and relate the impact of academic integrity to your own work as researcher and in your career

If you do not find the course on your Blackboard, please follow the instructions to self-enrol onto the course: [Plagiarism Awareness (Masters Students) 2018-2019](https://www.imperial.ac.uk/study/pg/graduate-school/students/masters/professional-development/plagiarism-online/)[PDF]

Master's programme administrators should decide the most appropriate time for their students to complete the course. Master’s students who progress to a doctorate at the College will not be expected to take the doctoral version of the course but will be reminded about the course 6 months prior to submission of their thesis.
Appendices

Appendix A – Indicative Module Content

Unless otherwise stated the pass mark for each module is 50% for MSc Advanced Students
Why study this module?
This course is designed to give students a firm foundation in the fundamentals of Materials Characterisation that will be required in subsequent years of study, in particular in their long research project and internships. The mission of Materials Characterisation is to explain the use of advanced techniques for the study of structure-property relationships in materials. The course content takes into account the exposure of the students to characterisation methods in years 1 and 2.

Learning Outcomes of this Module:

**Diffraction**
- On successfully completing this course, students will be able to:
  - Explain what X-rays are and describe their importance in structure determination.
  - Discuss the components contributing to the formation of a diffraction pattern.
  - Define and fully explain Bragg’s Law, the Laue equations, reflecting sphere construction and a reciprocal lattice.
  - Discuss the experimental challenges of obtaining a useful diffraction pattern.
  - Understand the importance of diffraction maxima for structure determination.
  - Fully explain the atomic structure factor in terms of X-ray scattering.
  - Explain the origin of systematic absences.
  - Index powder diffraction patterns for cubic systems.
  - Describe the similarities and differences between neutron and electron diffraction compared with X-ray diffraction.
  - Demonstrate an understanding of the use of Le Bail and Rietveld analysis techniques for diffraction analysis.

**Ion Beam Characterisation**
- On successfully completing this course, students will be able to:
  - Understand and discuss fundamental ion-solid interactions for a range incident ion energies, and ion beam types i.e. mono-atomic and cluster ion beams. This topic includes the modelling program, SRIM.
  - Understand ion beam interactions on materials, and how the sputtered material is used in different techniques e.g. secondary ion mass spectrometry (SIMS) and low energy ion scattering.
  - Understand and discuss the difference between these two techniques and origin of the measured species.
  - Understand the concept of, and calculate ion beam dose, and discuss how this influences ion beam analyses: static and dynamic SIMS.
  - Understand the important effects such as oxygen and caesium surface coverage on the efficiency of positive and negative secondary ion formation, respectively.
  - Understand the basic SIMS equation and the importance of sputter yield and ionisation efficiency.
  - Understand the concept of mass and depth resolution, and how they are influenced by experimental conditions.
  - Discuss the application of SIMS to surface analysis and its modes of operation including mass spectra, surface imaging and concentration depth profiling.
  - Understand the difference between time-of-flight, magnetic sector and quadrupole mass filters.
  - Understand the importance of vacuum levels in the instrumentation for high level detection analyses.
  - Understand the characteristics of primary ion sources such as liquid metal ion sources, and electron ionisation sources, and plasma sources.
Discuss characteristics of primary ion sources such as their brightness.
Understand the origin of channelling contrast obtained with highly collimated ion beams.
Understand and discuss the application and use of ion beam instruments in surface analyses and materials characterisations.

**Electron Microscopy**
On successfully completing this course, students will be able to:
- Explain wave-particle duality and discuss the wave properties of electrons.
- Discuss the concept of resolution.
- Describe the design and operation of scanning electron microscopes (SEM) and transmission electron microscopes (TEM), with particular reference to electron sources, electrostatic lenses and electromagnetic lenses.
- Describe specimen preparation techniques for SEM.
- Describe the specimen preparation for TEM.
- Discuss the types of aberration that can arise and current practical resolution limits for SEM and TEM.
- Discuss contrast mechanisms in SEM.
- Describe and explain secondary electron imaging and backscattered electron imaging in SEM.
- Discuss contrast mechanisms in TEM.
- Describe and explain bright-field imaging, dark-field imaging and diffraction pattern formation in TEM.
- Discuss the theory and use of energy dispersive X-ray analysis and electron energy loss spectroscopy.
- Discuss the scanning transmission electron microscope and the use of high-angle annular detectors for imaging.

**Scanning Probe Microscopies**
On successfully completing this course, students will be able to:
- Explain what scanning probe microscopy is.
- Discuss the lateral imaging range and sensitivity to structure and properties.
- Specifically describe the theory, use and operation of the scanning tunnelling microscope and atomic force microscope including strengths and weaknesses of each technique.
- Discuss applications of scanning probe microscopies to materials characterisation.

**Thermal analysis**
On successfully completing this course, students will be able to:
Describe the different types of thermal analysis techniques.
- Describe the limitations and challenges of the various techniques.
- Be able to select the most appropriate thermal analysis technique for a variety of characterisation investigations.
- Interprett thermal analysis data for simple materials.

**Reading List:**

**Required Reading**

**Recommended Reading**
* Structure from Diffraction Methods, D.W. Bruce, D. O’Hare and R.I. Walton, Wiley (2014)
Background Reading

How will I be Taught?
- 25 lectures: Autumn term (during week 2 and 3 of the Autumn term)
- 4 workshops
- 3 introductory laboratory sessions
- An open-ended characterisation exercise will take place in the Spring term, leading to a report due at the end of the Spring term.

How will I be Assessed?

Examination
The course is examined in the summer term. The examination paper, duration 2.5 hours, has 8 questions and is comprised of a mixture of short questions plus a long question that is based on analysing a series of experimental results and writing a reasoned interpretation of these data (50%).

Coursework
Students are expected to submit one report (35%) related to the open-ended characterisation exercise, complete a workshop (7.5%) and attend a number of practical sessions (7.5%).

Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced Materials programme is 50%.

(C2) MSE 467 (317) Materials Modelling

Module Leader: Prof Andrew Horsfield
Teaching Staff: Dr Yilun Xu, Dr Paul Tangney and Dr Hui Yang

Why study this module?
This course introduces students to a selection of important modelling techniques. It covers methods applicable to a range of length scales and materials types that can be used to solve practical problems in Materials Science and Engineering. Students will have an opportunity to use these methods by performing simulations using code that will be provided.

Learning outcomes:
- Introduction to computer simulation - Length and time scales
- Introduction to MATLAB
- Understanding Finite Elements and Crystal Plasticity
- Understand the algorithm for Metropolis Monte Carlo
- Apply Metropolis Monte Carlo to finding the equilibrium distribution of one or more particles
- Understand the diffusion equation and how to solve it using finite differences and Fourier Transforms
- Understand the merits of explicit and implicit solvers
- Apply kinetic Monte Carlo to solve the diffusion equation
- Understand the concept of a phase field
- Understand the relation of the free energy to the equation of motion of the phase field
- Understand the Cahn-Hilliard equation for spinodal decomposition
• Solve the Cahn-Hilliard equation for the spinodal decomposition of a binary alloy.
• Understand the concept of a potential energy surface in the context of aggregates of atoms
• Understand how the atoms’ real potential energy surface may be approximated to make atomistic calculations tractable.
• Understand the basics of how different types of bonding (ionic, covalent, metallic, van der Waals) are modelled.
• Understand what it means to find the minimum-energy structure of a molecule or crystal.
• Understand the molecular dynamics method for calculating finite temperature properties.
• Understand how to perform a Molecular Dynamics simulation (velocity Verlet) and a simple way to introduce the effect of a surrounding medium (Langevin dynamics).
• Understand a current research topic that employs computer simulation

Reading List:

How will I be Taught?
8 hrs lectures with 16 hrs of exercise classes (MEng and BEng), or 9 hours lectures with 18 hrs exercise classes (MSc): Spring term (a three hour session per week)

How will I be Assessed?
Assessment is through 3 problem sets, a 2 hour online multiple-choice test, and a research essay (MSc only).
For MSc students, the problem sets have equal weight and together are worth 60 marks; the test is worth 30 marks, and the essay is worth 10 marks.
Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced Materials programme is 50%.

(O01) MSE 457 (307): Engineering Alloys
Module Leader: Dr Ben Britton
Teaching Staff: Dr Minh-Son Pham and Dr Chris Gourlay

Why study this module?
This course is titled Engineering Alloys 1: From Theory to Applications
In this course students will draw together key concepts within the “processing-microstructure-properties-performance” domain to consider the opportunities and challenges of using engineering alloys in real components. This course is focussed around key case studies to translate theory and understanding into real-world applications.
This course is well placed to lead into the 4th year module “Engineering Alloys 2: A Crystal Approach”
Learning outcomes:

* You will consider engineering with alloys, and multi-objective engineering design problems (cost, temperature, performance – e.g. creep, fatigue, strength, processability, light weighting, material costs & lifecycle).
* You will discuss approaches to engineering design and lifing, where failure and optimisation of alloys dominate function (drawing in ideas of process-microstructure-properties) in solid stage metal components.
* You will realise a deeper understanding of the science of alloys as a microstructure system with an engineering goal. This includes exploring microstructure mapping and crystallographic texture evolution in engineering alloys.

How will I be Taught?

27 contact hours (includes lectures, workshops and a computational exercise): Autumn Term (2 x two hour sessions per week)

Reading List:

* The Superalloys, RC Reed, CUP, 2007
* Titanium, Lutjering and Williams, Springer, 2003
* The Jet Engine, Rolls Royce
* Metals Speciality Handbooks in Nickel and Titanium, ASM Int’l (Donachie)
* Introduction to Texture Analysis and Orientation Mapping, Valerie Randle and Olaf Engler, VRC Press 2009

How will I be Assessed?

Examination (80%)
The course is examined in the summer term in a single 2½ hour examination paper composed of five questions. Students answer 3 questions from the 5 available, each worth 20 marks giving a total of 60 for the paper. The balance of questions will broadly reflect the balance of lectures.

Coursework (20%)
Unit 6 includes a coursework based exercise, led during the lecture period. This includes development of understanding of crystallographic texture in engineering alloys.

Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced Materials programme is 50%.
Why study this module?

The overall aim of this course is to introduce students to the main methods and fundamental principles used for the processing of engineering ceramics (and, to a lesser degree, glass and glass ceramics) and develop an understanding of the factors that influence their mechanical properties. Furthermore, the course will give an introduction to microwave application of ceramics and discuss the electrodynamic response from dc to infrared frequencies and its correlation to the microstructure.

Learning outcomes:

- Describe the different types of particles (particles, agglomerates, granules, flocs, colloids, aggregates).
- Describe powder characterization methods. Interpret results from powder analysis (particle size, particle size distributions, specific surface areas).
- Understand the parameters that control powder packing and the dry pressing of ceramic powders.
- Explain the types of colloids and explain the different methods to stabilize colloidal suspensions (electrostatic stabilization, steric stabilization, electrosteric stabilization).
- Describe standard ceramic wet processing techniques and understand the key parameters in the formulation of ceramic slurries for processing.
- Describe the structure of glasses and their formation. Explain the models of glass structure: crystallite model and random network model. Describe the structure of oxide glasses: silica, silicate glasses, borate glasses.
- Understand the mechanical properties of ceramics in particular, fracture strength, Young’s modulus and fracture toughness.
- Appreciate the effect of microcracking on Young’s modulus.
- Appreciate the major effect of porosity and other microstructural features on mechanical strength.
- Understand thermal and time aging effects in ceramics, including creep, subcritical crack growth and thermal shock behaviour.
- Determine the relationship between microstructural features, in particular porosity, and thermal shock resistance.
- Understand the electrodynamic properties and high-frequency applications of ceramics.

Reading List:

How will I be Taught?

27 contact hours (includes lectures and class exercises): Spring Term (2 x two hour sessions per week)

How will I be Assessed?

The course is examined in the summer term. For MSc Advanced students the examination paper, duration 3 hours, has 6 questions and students must answer 3 plus one compulsory question (4 in total). The pass mark for the MSc Advanced Materials is 50%.

(O03) MSE 460 (310) Electronic Structures and Opto-Electronic Properties

Module Leader: Prof Jason Riley
Teaching Staff: Dr Mark Oxborrow

Why study this module?

This course describes the electronic devices used to emit light, transmit light and detect light and to show how these elements can be combined to create integrated systems for fibre optic communications, solar energy conversion and displays.

Learning outcomes:

* Explain the background physics necessary for an understanding of the optoelectronic properties of materials;
* Discuss how reflection and refraction give rise to colour from transparent materials;
* Describe the influence of microstructure on colour (scattering and diffraction);
* Illustrate the absorption and luminescence of light from a material;
* Design a material with a specified absorption edge;
* Rationalise the broad emission obtained from a phosphor;
* Describe a fibre optic communication link;
* Compare and contrast a fibre optic links and a copper wire for data communication;
* Describe the materials used and principles of operation of light emitting diodes (LEDs) working in the visible and infra-red parts of the electromagnetic spectrum;
* Describe semiconductor lasers with reference to band gap and refractive index engineering as well as optical feedback;
To discuss the economic and environmental viability of photovoltaic cells and define energy pay-back time;
Justify why silicon is a material used in solar cells despite the fact that it is an indirect band gap semiconductor;
Describe recent developments in silicon solar cell technology aimed at increasing efficiency and reducing unit cost;
Sketch the different phases a liquid crystal may exhibit and explain how the different phases can be characterised;
Explain why a chiral liquid crystal acts as a waveguide;
Sketch and clearly label the key components of a liquid crystal display.

Reading List:
- Introduction to Liquid Crystals: Chemistry and Physics. P.J. Collings.

How will I be Taught?
27 contact hours (includes lectures and class exercises): Spring Term (2 x two hour sessions per week) an additional 3 hours of contact hours for MSc Advanced students.

How will I be Assessed?
The course is examined in the summer term. For MSc Advanced students the examination paper, duration 3 hours, has 6 questions and students must answer 3 plus one compulsory question (4 in total). The pass mark for the MSc Advanced Materials is 50%.

(OO4) MSE 462 (312) Nanomaterials

Module Leader: Prof Mary Ryan
Teaching Staff: Prof Jason Riley and Dr Peter Petrov

Why study this module?
This course is designed to provide the student with a fundamental understanding of nanoscience and how this can be applied in technological devices. A mechanistic description of the structure / property relationships will be covered for each class of material with a focus on the specific advantages that nanoscale materials can provide. The student will gain an understanding of the processing routes to produce controlled nanostructures.

Learning outcomes:
- Explain the effect of nanoscale structure on the mechanical properties of materials
- Describe the formation, properties and applications of nanoporous materials
- Understand the effects of surface energy on the thermodynamics of nanoscale systems
- Describe bottom-up versus top-down routes for nanomaterials processing
Discuss nucleation versus growth of nanostructures and describe surface versus diffusion limited growth regimes.

Explain surface plasmon resonance in metals.

Discuss why the colour of metal nanoparticles differs from that of the bulk material.

Calculate the Bohr radius of an exciton.

Describe quantum confinement in semiconductor Q-dots.

Illustrate how nanowires can be employed in sensor applications.

Describe chemical and physical methods for thin film deposition.

Understand the architecture of the CMOS transistors currently used for fabrication of integrated circuits.

Describe the manufacturing and device performance challenges related to transistors size scaling down to 22nm, 14nm and below.

Give examples and discuss the manufacturing process of 2D and 3D CMOS devices.

Give examples of “post-CMOS” nanomaterials and devices.

Compare the methods for electrical testing of nanomaterials and thin film devices.

Understand and discuss the concept of responsible development; and discuss in general terms the potential impact of nanomaterials on human health and the environment.

Reading List:

- Nanostructures and Nanomaterials - Synthesis, Properties and Applications Guozhong Cao, Imperial College Press
- Metal Nanoparticles – Synthesis, Characterization and Applications D. Feldheim and C. Foss, Marcel Decker

How will I be Taught?

24 lectures: Autumn Term (2 x two hour sessions per week)

How will I be Assessed?

The course is examined in the summer term. The course is examined in the summer term. For MSc Advanced students the examination paper, duration 3 hours, has 6 questions and students must answer 3 plus one compulsory question (4 in total). The pass mark for the MSc Advanced Materials is 50%.

(O05) MSE 309: Polymers and Composites

Module Leader: Prof Milo Shaffer
Teaching Staff: Prof Eduardo Saiz and Dr Florian Bouville

Why study this module?

The overall aim of this course is to introduce students to the main methods and fundamental principles used for the processing of polymers and composite materials and to develop an understanding of the factors that influence their mechanical properties.

Learning outcomes:

- Identify and describe suitable methods to process polymers into useful products, including both blending and forming, for thermoplastics and thermosets.
Describe the characteristic rheology of polymers melts, and how the phenomenology controls the nature and quality of thermoplastic products, including the formation of defects

Introduce the major types of fibre reinforcement used in structural composites, and how they compare

Consider the nature of polymer composite matrices and the interface with the reinforcing fibres
to define a composite material, and give examples of common matrices and fibrous reinforcements, their properties and how they are made

explain the relevance of fibre flexibility and can quantify it

argue the advantages and disadvantages of classifying composites on the basis of matrix or architecture

make a quick assessment of realistic property ranges that can be obtained when making a composite of 2 materials
discuss a range of failure modes for fibre reinforced composites (axial and transverse tensile failure, axial compression failure)

appreciate the key engineering and scientific reasons for the development of metal-matrix composites
describe and classify processing technologies for metal-matrix composites

Reading List:

- RJ Young and PA Lovell “Introduction to polymers” Chapman and Hall 1983
- CB Bucknall “Toughened Plastics” Applied Science 1977 (Dated Introductory parts only)
- Concise Encyclopaedia of Composite Materials, ed. by A. Kelly, Elsevier, 1999
- K. K. Chawla, Ceramic Matrix Composites, Chapman and Hall, 1993
- Handbook of Ceramic Composites, ed. by N. P. Bansal, 2005

How will I be Taught?

27 contact hours (includes lectures and class exercises): Spring Term (2 x two hour sessions per week)

How will I be Assessed?

The course is examined in the summer term. The examination paper, duration 2.5 hours, has 5 questions. Students are required to answer 3 questions.

The pass mark for the MSc Advanced Materials programmes is 50%.
Why study this module?

This course is designed to give students the firm foundation in the fundamentals of Biomaterials required in subsequent years of study for those taking Advanced Biomaterials in year 4 and for those taking the MEng in Biomaterials and Tissue Engineering and to serve as a self-standing unit.

The mission of the Biomaterials module is to explain the types and properties of materials needed for various medical applications and how to synthesise and characterise these materials.

Learning outcomes:

* Identify various components of the human body, describe their function and explain the effects of ageing on the structure and mechanical properties of various groups of tissues and organs.
* Describe the major classes of biomedical implant materials, their means of fixation, stability and advantages and disadvantages when used as implant devices.
* Explain the types of failure of implants and devices in various clinical applications and reasons for failure.
* Describe the physiological principles involved in the replacement of various parts of the body with transplants or tissue engineered constructs and the clinical compromises involved.
* Defend the relative merits of replacing a body part with a tissue engineering construct, discuss the principles involved in growing body parts in vitro and describe the physiological and clinical limitations involved.
* Be able to communicate alternative means to repair or replace parts of the body to both healthcare professionals and patients.

Reading List:


How will I be Taught?

24 lectures: Autumn Term (2 x two hour sessions per week)

New material will be introduced to you in lectures. You will have an opportunity to test your understanding of the material through non-assessed problem sheets that will be reviewed in lectures.

The module is delivered to students from different departments. To bring all the students from different backgrounds up to speed the cohort will be, after an introductory lecture, split into two groups for the following two lectures; Materials and Mechanical Engineering students are given two lectures on basic concepts in biology for engineers, whilst Bioengineering students are given an introduction to the properties and structure of metals, ceramics, polymers and composites.
How will I be Assessed?

The course is examined in the summer term. The examination paper, duration 2.5 hours, has 5 questions of which students must answer 3 (20 marks per question).

The pass mark for the MSc Advanced programme is 50%.

(O07) MSE 404 Modelling Materials with Density-Functional Theory

Module Leader: Dr Johannes Lischner
Teaching Staff: TBC

Why study this module?

This course will introduce students to the modelling of materials with density-functional theory. After a brief review of the quantum-mechanical foundations of density-functional theory, the course will focus on the application of this technique to the calculation of material properties, such as elastic constants, equilibrium structures, phase diagrams or band structures. The concepts introduced in the lectures will be put to practical use in the computer lab session, where students will learn to use a density-functional theory software package and compute the properties of real materials from first principles.

Learning outcomes:

• Explain the basic principles and capabilities of materials modeling with density functional theory (DFT)
• Explain the quantum-mechanical basis of DFT and its limitations
• Use a standard DFT software package to compute material properties, including
  • The total energy of the electronic ground state
  • Atomic forces using the Hellmann-Feynman theorem
  • Equilibrium structures of molecules and crystals
  • Elastic constants
  • Energies of vibrations in molecules and solids
  • Phonon band structure and density of states
  • IR and Raman intensities
  • Cohesive energies
  • Phase diagrams
  • Electronic band structures of metals, insulators and semiconductors
  • The dielectric function of a solid and optical properties
  • The effect of approximations to exchange and correlation on calculated properties
  • The effect of pseudopotential approximations on calculated properties

Reading List:

• Introduction to Quantum Mechanics, D. J. Griffith, Pearson Education International, 1995
How will I be Taught?

12 lectures and 12 computer lab sessions: Autumn Term (a three hour session per week)

How will I be Assessed?

Assessment is through weekly problem sets and a written exam. The problem sets are worth 40% and the exam 60%.

Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced programmes is 50%.

(O08) MSE 409 Advanced Engineering Alloys

Module Leader: Prof Fionn Dunne
Teaching Staff: Dr Chris Gourlay

Why study this module?

This course titled ‘Engineering Alloys 2: A Crystal Approach’ and builds on knowledge acquired from MSE307 (Engineering Alloys) and addresses aspects of processing (particularly casting) through to resultant microstructure and properties, and then considers alloy structural behaviour and performance in service under mechanical and thermal loading.

The links between processing, microstructure, properties and performance of engineering alloys in service are emphasised. Two case studies, one in each of processing and performance, are included to relate the course content to engineering practice and to reinforce the process-microstructure-properties-performance paradigm.

Learning outcomes:

- use heat transfer approaches to calculate and estimate casting parameters
- understand interface undercooling and constitutional supercooling and their role in (i) the columnar-to-equiaxed transition and (ii) the control of grain size.
- understand the physical basis for the Jackson-Hunt equations for regular eutectic growth and use it to predict interphase spacings and eutectic morphologies
- understand competitive solidification criteria for single phase dendrites vs. fully-eutectic growth;
- calculate simple microstructure selection maps from solidification models and data, and use them to predict microstructures from processing parameters.
- use all of the above to discuss microstructure selection in light alloy castings for aerospace applications
- understand generalized crystal deformation – stretch, slip and rigid body rotation
- understand slip in fcc, bcc, and hcp crystal lattices and slip systems, Schmid rule, strain from slip, strain and rotation rates
- understand and use slip rules and slip by dislocation glide and thermally-activated climb; self and latent hardening
- understand EBSD, texture and its representation, pole figures and Kearns factors;
- cold dwell fatigue in the Ti alloys; mechanistic assessment, crystallography; role of rate sensitivity; load shedding; microstructure (morphology and micro-texture); thermal alleviation
Reading List:

- Links to underpinning scientific journal papers are provided on WebCT

How will I be Taught?

24 lectures in the Spring Term ((2 x two hour sessions per week)

How will I be Assessed?

The course is examined in the summer term. The examination is 2.5 hours and consists of 5 questions, of which the students have to answer 3. Questions could be from a single part of the course or be more general in nature and require the students to use elements from several parts of the course.

The pass mark for the MSc Advanced programme is 50%.

(O09) MSE 410 Advanced Thin Film Manufacturing Technologies

Module Leader: Dr Peter Petrov

Why study this module?

This course titled ‘Advanced Thin Films Manufacturing Technologies’ and aims to familiarise students with the basic vacuum technologies; explain the essential concepts involved in using vapour deposition techniques to develop thin films; provide a foundation required to successfully use lithographic and other microfabrication methods; provide students with the basics for working in, and understanding the microfabrication in production environment and provide hand-on experience in thin film deposition.

Learning outcomes:

- Explain the principles of vacuum production and its classification.
- Understand the working principles and limitations of the vacuum pumps and gauges.
- Understand essential concepts involved in using vapour deposition techniques to.
- Describe the most common types of vapour deposition technologies (chemical vapour deposition (CVD), physical vapour deposition (PVD) and mixed deposition).
- Explain the three basic PVD techniques: vacuum evaporation (thermal/e-beam evaporation), sputter deposition (DC-, RF-, reactive- magnetron sputtering) and pulsed laser deposition.
- Discuss the connection between vapour deposition parameters and thin film properties.
- Identify the most appropriate method/equipment for a deposition process and discuss its advantages and disadvantages.
- Understand the characteristics and practical limitations of basic lithographic methods used for integrated circuit manufacturing.
- Discuss and compare the etching methods used in a microfabrication process
• Identify the most appropriate method and equipment for a patterning process and outline their principles of operation and limitations.

• Understand the basics principles for working in hi-tech (e.g. semiconductor) production environment.

• Know the ‘Clean room’ classification, its design principles and control measures.

Reading List:


• Fundamentals of Vacuum Technology (revised and compiled by W Umrah) Oerlikon Leybold Vacuum 00.200.02 Kat.-Nr. 199 90

How will I be Taught?

18 lecture hours and 3 lab sessions (2 hours each) in the Autumn Term ((2 x two hour sessions per week)

How will I be Assessed?

Examination (70%)

The course is examined in the summer term. The exam is 2.5 hours and consists of 5 questions from which the students must answer 3.

Lab-work (30%)

Each Lab-work (three in total) is assessed on the base of the following criteria:

i) preparation for the Lab session (40%) – 15-20 min Q&A session before the experimental work starts

ii) engagement in the experimental work (20%),

iii) Lab report (40%) – It has to be submitted within one week after the Lab-session.

Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced programme is 50%.

(O10) MSE 411 Electroceramics

Module Leader: Prof Stephen Skinner

Teaching Staff: Dr Ainara Aguadero

Why study this module?

The aim of the course is to gain an understanding of the fundamental science governing the electronic and ionic conductivity of metal oxides and to then use this knowledge to describe the operation of devices based on these properties, such as gas sensors, fuel cells, batteries and thermoelectric.

Learning outcomes:
• Obtain a full set of algebraic expressions for the point defect concentrations in pure and doped oxide materials.
• Identify suitable approximations to the full neutrality condition, and hence solve the defect equations and construct a simple Brouwer diagram for a binary oxide.
• Construct expression for the incorporation of extrinsic defects and incorporate this in the Brouwer diagram.
• Discuss type of conductivity and applicability of materials in electrochemical systems.
• Describe the operation of secondary batteries. Identify different electrode reaction mechanism in secondary batteries.
• Analyse electrochemical performance in terms of the band theory of solids.
• Discuss electrode and electrolyte materials chemical and electrochemical stability properties.
• Describe different types of solid electrolytes and ionic conduction mechanisms for alkaline ions.
• Discuss relationships between crystal structure, composition and morphology with transport properties.
• Identify novel materials for ceramic based devices. Explain further alternatives for high energy batteries development.
• Explain the concept of anionic, cationic and mixed conductors.
• Derive a simple relationship for the operation of a ceramic membrane device and use this expression to select appropriate materials for the fabrication devices such as a single SOFC cell.
• Explain the operation of a fuel cell and give an account of the basic details of the four main types of cell.
• Describe the operation of two oxide-based sensors.
• Describe a further sensor based on the amperometric technique.
• Describe two simple sensors for the detection of flammable gasses.
• Brief introduction to thermoelectric materials.

Reading List:
• Electroceramics, A.J.Moulson and J.M.Herbert
• Physical Ceramics, Chiang, Birnie and Kingsley, John Wiley and Sons (1997)
• Electronic Ceramics properties Devices and Applications Lionel M. Levinson. Marcel Dekker (1988)
• Fuel Cell systems explained, James Larminie and Andrew Dicks, Wiley (2003)

How will I be Taught?
24 lecture hours in the Autumn Term (2 x two hour sessions per week)

How will I be Assessed?
The course is examined in the summer term. The examination paper, duration 2.5 hours, is in two sections. Section A (20 marks) is compulsory and consists of a single question on all parts of the course. Section B contains 3 questions of which students must answer 2 (20 marks per question).

The pass mark for the MSc Advanced programme is 50%.
Why study this module?

This course is designed to provide the students with an insight into the emerging applications of nanotechnology through a series of topically relevant case studies. The underlying nanoscience as well as the engineering aspects of material and device operation is given. The broader societal impacts of nanotechnology and its impact on human health are explored.

Learning outcomes:

- Discuss the chemical characteristics of layered compounds and their elementary building blocks
- Describe the electronic band structure of graphene and group VI of transition metal disulphide and diselenide.
- Discuss the properties of these materials relevant for applications
- Discuss the chemical vapour deposition synthesis method for these materials.
- Discuss the liquid phase exfoliation route to obtain atomically thin sheets from bulk powders.
- Quantify the scalability of different energy conversion technologies for our future energy needs
- Explain the role of the electrocatalyst in controlling the efficiency of low temperature fuel cells and water electrolysis
- Discuss trends in catalytic activity due to (i) particle size (ii) alloying
- Identify fundamental bottlenecks in emerging electrochemical reactions: N₂ reduction and CO₂ reduction
- Understand the general synthetic routes including top-down and bottom up methods
- Be able to describe the possible growth mechanism of metal nanoparticles including Au, Ag, and Pd
- Understand the optical properties of metal nanoparticles and their size/shape dependency
- Be able to describe metal nanoparticles’ application in medical diagnosis, therapy, and solar energy conversion.
- Describe the routes of exposure of nanoparticles to the body.
- Understand and discuss the effect of shape, size and chemistry of nanostructures on the interaction of nanoparticles with the body.
- Assess critically the potential risk of nanoparticles to human health.

Reading List:

- Nanostructures and Nanomaterials - Synthesis, Properties and Applications Guozhong Cao, Imperial College Press
- Metal Nanoparticles – Synthesis, Characterization and Applications D. Feldheim and C. Foss, Marcel Decker

How will I be Taught?

21 lecture hours in the Spring Term ((2 x two hour sessions per week) and 3 hrs of poster presentation.

How will I be Assessed?

The course is examined in the summer term. The examination paper, duration 2.5 hours is in 2 sections. Section A contains 5 short calculation-type questions (6 marks each); section B contains 2 essay questions (20 marks each). All questions are compulsory.

Coursework

30 marks are associated with the poster exercise (preparation and presentation).

Assignment coursework forms will be uploaded in the relevant Blackboard Learn folder. The pass mark for the MSc Advanced programmes is 50%.
Why study this module?

This course is designed to review microstructural aspects of the behaviour of major ceramic families such as alumina, silicon carbide, silicon nitride, zirconia and glass and contrast microstructural control aimed at improving strength/toughness and to re-examine the general theoretical concepts underpinning the structural performance of materials developed in MSE 203 Mechanical behaviour with an aim to strengthen the students ability to apply the general principles to ceramics.

Learning outcomes:

- State a range of classical families of advanced structural ceramics including alumina, zirconia, silicon nitride, silicon carbide and ceramic matrix composites
- List and explain approaches to improve the strength and toughness of these materials
- List and explain a range of ceramic composite approaches and their failure modes
- Distinguish between inherent toughness, apparent toughness, and fracture energy
- Predict crack progression for stable cracking and for materials with R-curve behaviour
- Have some understanding of possible fatigue effects in ceramics
- Inspect a ceramic fracture surface and determine failure origin, and failure type
- Estimate the probability of failure for simple loading cases
- Incorporate proof testing or non-destructive evaluation in a reliability strategy
- Outline a design methodology for complex ceramic components based on probability of failure
- Compare and contrast deformation behaviour of ceramics with other materials
- Identify the deformation mechanisms active in ceramics
- Understand the importance of thermo-mechanical properties at temperature
- Understand the thermodynamics and kinetics behind degradation mechanisms of ceramic at high temperature due to stress including creep, fatigue and thermal shock, due to corrosion or due to radiation
- Describe applications of high temperature ceramics and why they are used thermal protection systems, thermal barrier coatings in jet engines, and processing equipment in glass making, steel making and other industrial high temperature processes.

Reading List:

- Links to research papers are provided on Blackboard
- Ceramic Microstructures, Property Control by Processing, WE Lee and WM Rainforth, (Chapman & Hall 1994)

How will I be Taught?

24 lecture hours in the Autumn Term ((2 x two hour sessions per week).

How will I be Assessed?

The course is examined in the summer term. The exam paper is 2.5 hours and consists of 5 questions, students should answer 3 questions.

The pass mark for the MSc Advanced programme is 50%.
Why study this module?

The course will assume students have at least a basic understanding of a reactor system. The aim is then to develop an appreciation of materials issues associated with nuclear reactor technology and how this information is used when designing reactor systems. A mechanistic description of materials selection for intense radiation fields and the associated degradation mechanisms will be covered for different classes of material with a focus on the specific advantages and disadvantages. The course will then cover specific cases where materials issues have been crucial to systems performance and a variety of degradation and failure mechanisms as well as the radiation damage processes that brought about these failures. NB: Although not solely focused on water reactor systems (especially PWR) the course will be aimed at this system.

Learning outcomes:

- Review radiation types, radioactive decay and dose units.
- Discuss the mechanisms of radiation damage of nuclear materials, the units used to measure damage and the models behind them.
- Recall the types of fuel and components for the Nuclear Fuel Assembly.
- Discuss the fuel cycle and fuel fabrication.
- Explain the use of different materials (stainless steels, Ni alloys) used in a PWR primary circuit and the problems and mitigation strategies associated with them.
- Understand the microstructure and mechanical properties of ferritic steels used for reactor pressure vessels (including welded structures) and the degradation of the steels due to neutron irradiation.
- Outline the motivation for zirconium as a cladding in PWR environments.
- Discuss alloying of zirconium for cladding materials.
- Discuss engineering decisions for tube fabrication, as well as a simple overview of the benefits and disadvantages of different joining technologies.

Reading List:

- G S Was “Fundamentals of Radiation Materials Science” Springer (978-3-540-49471-3).

How will I be Taught?

24 lecture hours in the Autumn Term (a three hour session per week).

How will I be Assessed?

The course is examined in the summer term, and the students answer any 3 of 5 questions.

The pass mark for the MSc Advanced programme is 50%.
(O14) MSE 417 Advanced Biomaterials

Module Leader: Prof Julian Jones
Teaching Staff: Dr Stefano Angioletti-Uberti and Prof Alexandra Porter

Why study this module?

The course aims to introduce students to the latest developments in hard tissue biology.

Learning outcomes:

- Explain the shortfalls of bone and cartilage implants materials to the biomaterials industry and investors.
- Have knowledge of commercially available bone graft replacement materials and be able to discuss their benefits and shortfalls.
- Design ideal scaffold materials for bone and cartilage regeneration.
- Explain the concept of therapeutic nanoparticles.
- Be familiar with advanced microscopy techniques for following nanoparticles within cells
- Explain the concept of hybrid materials and their potential benefits for regenerative medicine over composites
- Explain the synthesis method for hybrid biomaterials and how it relates to their unique properties
- Discuss 3D printing methods for scaffold production
- Discuss antiviral nanoparticles
- Describe hydrophillic / hydrophobic interactions between materials and proteins using mathematical operations
- Mathematically define ligand-receptor interactions
- Explain how cells can be targeted by nanoparticles and discuss the efficiency of targeting.
- Discuss the deformation of soft membranes
- Explain the challenges involved with transfer of laboratory inventions to a clinical product
- Production and application of HA and bioactive glass nanoparticles
- Cell uptake routes and nanotoxicity of classes of nanoparticles
- Describe cancer treatment through the use of particles
- Discuss new biomaterials for healing of chronic wounds.

Reading List:

- Various printed publications

How will I be Taught?

24 lecture hours + 3 feedback in the Spring Term (2 x two hr sessions per week) and a revision lecture in the Summer Term

Students will complete a practical Dragon’s Den exercise in groups. This will aim to give an understanding of the mechanism and stages needed to take a new device from concept to clinic.

How will I be Assessed?

The course is examined in the summer term. The exam is 2.5 hours in duration and consists of 5 questions, from which students must answer 3 questions (each marked out of 20).

The pass mark for the MSc Advanced programme is 50%.
Why study this module?

Aims:
The course will introduce students to key concepts and recent developments in soft tissue engineering, with a particular focus on biomaterials-based approaches. This is a highly dynamic and rapidly developing field, with rapid advances in both fundamental biology and biomaterials design driving a stream of new clinical and pre-clinical approaches.

Context/Prerequisites:
Students not taking MSE315 must have a basic foundation in cell biology, e.g. from BioEng core courses, Biochemical Engineering modules or courses taken at another university. MSE418 focuses on soft tissues and biomaterials in contrast to MSE417 which is centred on hard tissues and biomaterials: these modules may be taken in combination or separately.

Course content
- **Cellular responses to the local environment**: We aim to understand the principles of how cells sense and respond to the physical and chemical properties of biomaterials and of the in vivo environment.
- **Polymeric materials in tissue engineering**: Soft tissue engineering biomaterials are typically polymers and students will learn how these materials are synthesized and characterized.
- **Clinical aspects of tissue engineering**: Students will learn key clinical concepts and study clinical and pre-clinical case studies in soft tissue engineering.

Sample learning outcomes:
- Describe and explain the principles of cellular mechanotransduction.
- Describe various strategies to fabricate porous materials.
- Give examples of the applications of scaffolds for tissue engineering of heart, eye, liver, kidney and the nervous system.

Reading List:

How will I be Taught?
27 lecture hours in the Spring Term (a three hr session per week)

How will I be Assessed?
The course is examined in the summer term. The paper is 2.5 hours and students are required to answer 3 questions from the 5 set on the examination paper.

The pass mark for the MSc Advanced programme is 50%.
(O16) Fusion and Advanced Reactors

Module Leader: Dr Ben Britton

Teaching Staff: Dr Mark Wenman, Dr Mike Bluck, Professor Christos Markides, Dr Hanni Lux Dr Christopher Ham and Prof Sergei Dudarev

Aims

This module is designed to provide an introduction to next generation nuclear reactor concepts and ideas, including nuclear fusion and the advanced fission reactor (e.g. GenIV) landscape.

Fusion: Understand what drives the need for completely new energy sources, such as fusion; clarify the underlying science and technology challenges including the role of materials development; understand the progress to date and how this is expected to impact on the potential for fusion power as an energy system.

Advanced reactors: Advanced reactor concepts represent the next generation of nuclear fission reactor technologies, with aims towards energy creation which addresses more than just electricity (e.g. hydrogen production), as well as the ability to breed a mixture of nuclear fuel streams (including molten salts, thorium, and waste actinides), and the operation of reactors at higher temperatures. These reactors will operate in a new engineering space, where cost, scalability with an intermittent grid (e.g. renewables), time to market, and engineering opportunity will be seized upon.

Reading List:
- ‘Physics of Plasmas’ by Boyd and Sanderson CUP
- Fusion, the Energy of the Universe, McCracken, Stott, Academic Press.
- Tokamaks, Wesson, OUP.
- IWGFR "Status of Fast Reactor Research and Technology Development, TECDOC 1691", IAEA, Vienna 2013

How will I be Taught?
16 hours of lectures, 7 hours of tutorials: Autumn term

How will I be Assessed?
One hour online multiple choice test on fusion power. (50%)
Four pieces of coursework on advanced reactors. (50%)

The pass mark for the MSc Advanced programme is 50%.

For module descriptors for the following modules see the website links below:
(O17) ME4-MNUTH Nuclear thermal Hydraulics https://www.imperial.ac.uk/engineering/study/current/inter-departmental-exchange-idx/me4-mnuth/
(O18) ME4-MNURP Nuclear Reactor Physics https://www.imperial.ac.uk/engineering/study/current/inter-departmental-exchange-idx/me4-mnurp/
(O19) CE4-30 Nuclear Chemical Engineering https://www.imperial.ac.uk/engineering/study/current/inter-departmental-exchange-idx/ce4-30/
## Appendix B

### Head of Department:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Office</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof Peter Haynes</td>
<td>PDH</td>
<td>201B</td>
<td><a href="mailto:p.haynes@imperial.ac.uk">p.haynes@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Prof Neil Alford</td>
<td>NMA</td>
<td>205</td>
<td><a href="mailto:n.alford@imperial.ac.uk">n.alford@imperial.ac.uk</a></td>
</tr>
<tr>
<td>Dr Ainara Aguadero</td>
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Welcome to Imperial College London and the Graduate School!

The Graduate School is responsible for the postgraduate experience at the College and we work closely with the Union and the Graduate Students’ Union to ensure that when decisions are being made, which affect your time at Imperial, your voice is heard. Another important aspect of our role is to offer you a free and exciting range of professional development opportunities which you can access from wherever you are in the world. Whether you wish to pursue a career in academia, industry or something else, professional development training will improve your personal impact and will help you to become a productive and successful researcher.

The Graduate School also runs a number of exciting social events and competitions throughout the year which are an opportunity to broaden your knowledge as well as to meet other students and have fun. You should regularly check the Graduate School’s website, blog, social media and e-Newsletters to keep up to date with all the latest activities available to you.

Finally, Imperial College is an extremely exciting, stimulating and diverse environment in which to work, to study and to research, do make the most of all that the College and your programme has to offer.
Welcome from the Graduate Students’ Union (GSU)

I am delighted to welcome you to Imperial College! Let me introduce you to the Graduate Students’ Union (GSU).

We are the elected representative body standing up for your interests as a postgraduate student. In addition, we are here to help you to make the most of your time at Imperial. We work towards building a thriving and enjoyable postgraduate community, spanning across all faculties and campuses at Imperial College.

As a postgraduate student, there are facilities and events available just for you. The graduate school provides a range of invaluable courses ranging from communication to professional progression to business skills courses. Our student Union has over 100 different societies for you to get involved in, ranging from boxing to consulting. You also have your own, graduate only, bar (h-bar) which opens Monday to Friday from 5pm till late with tapas style food and events every week ranging from Karaoke to weekly pub quizzes.

So, what are we up to for this coming year? We are going to focus on these major areas of action:

- Develop the GSU to become central to the postgraduate community by improving the two-way flow of information, between the GSU and you across all campuses;
- Improve services at h-bar to your needs;
- Organise exciting events such as student well-being workshops and entrepreneurship opportunities throughout the year;
- Continue improving postgraduate well-being by increasing the quality of supervision, and by creating strategies to tackle common mental health challenges in higher education.

We are here to make your time here as enjoyable and beneficial as possible, if you have thoughts, ideas or feedback, make sure you get in touch! Finally, I hope that you have a fantastic time here at Imperial and take advantage of the richness of opportunities that await you.

Mohit Devgan

GSU President 2019-20
gsu.president@imperial.ac.uk
www.imperialcollegeunion.org/your-union/how-were-run/constituent-unions/graduate-students-union