Programme Specification for the MSc in Composites: the Science, Technology and Engineering Application of Advanced Composites

PLEASE NOTE. This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. This specification provides a source of information for students and prospective students seeking an understanding of the nature of the programme and may be used by the College for review purposes and sent to external examiners. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the course handbook or on-line at: [http://www3.imperial.ac.uk/aeronautics/pg/comp/students](http://www3.imperial.ac.uk/aeronautics/pg/comp/students)

The accuracy of the information contained in this document is reviewed by the College and may be checked by the Quality Assurance Agency.

1. **Awarding Institution:** Imperial College London
2. **Teaching Institution:** Imperial College London
3. **External Accreditation by Professional / Statutory Body:** Royal Aeronautical Society (RAeS), Institution of Mechanical Engineers (IMechE) and Institute of Materials, Minerals and Mining (IOM3)
4. **Name of Final Award (BEng / BSc / MEng etc):** MSc
5. **Programme Title (e.g. Biochemistry with Management):** Composites: the Science, Technology and Engineering Application of Advanced Composites
6. **Name of Department / Division:** Aeronautics
7. **Name of Faculty:** Engineering
8. **UCAS Code (or other coding system if relevant):** J5U1
9. **Relevant QAA Subject Benchmarking Group(s) and/or other external/internal reference points:** Engineering
10. **Level(s) of programme within the Framework for Higher Education Qualifications (FHEQ):**

| Master’s (MSc, MRes) | Level 7 |

11. **Mode of Study** The programme is available as a 1 year full time course and a 2 year part time course.

12. **Language of Study:** English

13. **Date of production / revision of this programme specification (month/year):**

    July 2015

14. **Educational aims/objectives of the programme**

    1 MSc in Composites
The course aims to provide a broad education in all aspects of the science and technology of composite materials for students coming from widely different backgrounds in science and engineering. There is an accentuation on group working and presentational skills throughout the course. Specialisation is allowed for via project work.

The emphasis given throughout the course is to set composite materials in context against other materials and, hence, to show the circumstances under which they might best be used by all sectors of industry. In addition to mechanical performance, attention is given to costs, ease of fabrication, durability, and other factors which impinge on creating viable industrial products.

The intended student learning experience: To provide a high quality, broadly based education, involving both theory and practice, in the whole area of the science and technology of composite materials, delivered by experts in their field, who are committed teachers, communicators and researchers. This is achieved by interdepartmental collaboration in the delivery of the course, together with invited lecturers from other universities, industry, research organisations and the Ministry of Defence.

The programme aims to:

- produce graduates equipped to pursue careers in Composite Materials, in industry, the public sector and non-governmental organisations;
- provide the basis for the recognition and understanding of the major features of Composite Materials;
- develop an understanding of how this knowledge may be applied in practice in an economic and environmentally friendly fashion;
- foster the acquisition and implementation of broad design, research and analytical skills related to Composite Materials;
- attract highly motivated students from a range of engineering and science backgrounds, both from within the UK and from overseas;
- develop new areas of teaching in response to the advance of scholarship and the needs of vocational training;
15. Programme Learning Outcomes

1. Knowledge and Understanding

<table>
<thead>
<tr>
<th>A. Knowledge and understanding of:</th>
<th>Teaching/learning methods and strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a selection of the major topics in the subject, their recognition and underlying fundamental</td>
<td></td>
</tr>
<tr>
<td>principles;</td>
<td>Acquisition of A1 to A4 is through a combination of lectures, seminars, laboratory work and coursework.</td>
</tr>
<tr>
<td>2. research techniques which might include information retrieval, experimental design,</td>
<td></td>
</tr>
<tr>
<td>manufacture and modelling;</td>
<td>A4 is also supported by attendance at a number of skills workshops.</td>
</tr>
<tr>
<td>3. the essential facts, concepts, principles and theories relevant to the student’s chosen area</td>
<td></td>
</tr>
<tr>
<td>of research;</td>
<td>Throughout the students are encouraged to undertake independent reading both to supplement and</td>
</tr>
<tr>
<td>4. management and communication skills, including problem definition, project design,</td>
<td></td>
</tr>
<tr>
<td>decision processes, teamwork, written and oral reports, scientific publications.</td>
<td>consolidate what is being taught/learnt and to broaden their individual knowledge and understanding of</td>
</tr>
<tr>
<td></td>
<td>the subject.</td>
</tr>
<tr>
<td></td>
<td>Assessment of the knowledge base is through a combination of unseen written examinations (A1-4) and</td>
</tr>
<tr>
<td></td>
<td>assessed coursework (A1-4) as well as an individual literature review, presentation and dissertation</td>
</tr>
<tr>
<td></td>
<td>focussing on the investigative project (A1-4).</td>
</tr>
</tbody>
</table>
2. Skills and other Attributes

### B Intellectual (thinking) skills - able to:

1. analyse and solve problems using a multidisciplinary approach, applying professional judgements to balance costs, benefits, safety and social and environmental impact;
2. integrate and critically evaluate information;
3. formulate and apply appropriate solutions;
4. plan, conduct and write-up a programme of original research.

#### Teaching/learning methods and strategies

Intellectual skills are developed through the teaching and learning methods outlined above and in section 17.

Assessment is through coursework, unseen written examinations, project reports and oral presentations.

### C Practical skills – able to:

1. plan and execute safely a series of experiments or computations;
2. use laboratory methods or computer-based tools to generate data;
3. analyse results, determine their strength and validity, and make recommendations;
4. prepare technical reports;
5. give technical presentations;
6. use the scientific literature effectively;

#### Teaching/learning methods and strategies

Practical skills are developed through the teaching and learning programme outlined above (and in section 17). Practical experimental or computational skills (C1 to C3) are developed through project work and coursework, and through interaction with other research students and the research supervisor(s). Skills C4 and C5 are taught and developed through workshops, feedback on written reports and presentations. Skill C6 is developed through lectures, coursework reports and the individual supervised major project.

Practical skills are assessed where appropriate through the project reports and presentation.
Transferable Skills

**D Transferable skills**  — able to:

1. communicate effectively through oral presentations, computer processing and presentations, and written reports;
2. apply knowledge and modelling skills;
3. management skills: decision processes, objective criteria, problem definition, project design and evaluation needs;
4. integrate and evaluate information from a variety of sources;
5. transfer techniques and solutions from one discipline to another;
6. use Information and Communications Technology;
7. manage resources and time;
8. learn independently with open-mindedness and critical enquiry;
9. learn effectively for the purpose of continuing professional development;
10. develop group working skills.

**Teaching/learning methods and strategies**

Transferable skills are developed through the teaching and learning programme outlined above and in section 17.

Skill D1 is taught through workshops and feedback on reports and oral presentations.

Skill D2 is taught through lectures and practical work and developed, as appropriate, during the individual research project.

Skills D3 to D5 are developed through project work.

Skill D6 is developed through workshops, computer-based exercises, projects and other coursework activities and individual learning.

Skill D7 is developed throughout the course within a framework of staged coursework deadlines and the examination system.

Although not explicitly taught, skills D8 and D9 are encouraged and developed throughout the course, which is structured and delivered in such a way as to promote this.

Skill D10 is developed through group design project work.

16. The following reference points were used in creating this programme specification

- Student Handbook for the course

17. Programme structure and features, curriculum units (modules), ECTS assignment and award requirements

**Programme Structure**

The programme is offered as a full-time one-year course (or two years part-time) and leads to the MSc degree. The course is composed of core modules that are taught in the first term (October-December) and second term (January-March), see below. During the first term students follow a comprehensive laboratory programme that forms the basis for a series of assessed reports. These reports, together with a literature survey, which is also carried out in the first term and a group design project that takes place in the second term constitute the coursework element of the course. An
individual investigative research project, leading to a dissertation, is carried out continuously from May through to the end of September. From May onwards, all student time is devoted to this research project.

Student achievements that demonstrate successful completion of the course are:
Coursework: A minimum of 50% overall on 4 laboratory reports and the laboratory log book (out of 12 separate group laboratory periods), 4 related assignments (1 a group effort), 1 literature survey (including an oral presentation), 1 group design project (also including an oral presentation).

Written examinations: Minimum of 50% overall (no lower than 37.5% in any individual examination) in 4 closed book examinations.

Research project: Minimum of 50% overall for the dissertation, oral presentation and application.

Term content breakdown for one year, full-time attendance

Term one:
Laboratory Sessions: Composite prepreg lay-up, Test piece preparation, Tensile testing, Flexural testing, Compression testing, Fracture toughness, Shear testing, Distortion of channels
Literature Review (undertaken during non-timetabled time)

Term Two:
Literature Review (Completed in the first few weeks during non-timetabled time)
Design Study: A group exercise to perform preliminary design of an appropriate composite component.

Term Three (May-Sept inc.):
Examinations take place during the first two weeks of term three.
Research Project

Term content breakdown for two year, part-time attendance

Year one

Term one:
Part-time students attend all the lectures and laboratory exercises and complete the associated coursework (including the Literature Review) as for the Full-time students.

6 MSc in Composites
Term two:
Part-time students do not undertake any scheduled activity for the course but they are required to complete the Literature Review.

Term three:
Examinations: Part-time students take two examination papers on the lecture courses taken in the first term of year one.
Research Project: Part-time students may begin work on the individual research project.

Year two

Term one:
Part-time students do not undertake any scheduled activity for the course.

Term two:
Part-time students attend all the lectures, complete the associated coursework (including the Group Design Project) as for the Full-time students.

Term three:
Examinations: Part-time students take two examination papers on the lecture courses taken in the second term of year two.
Research Project: Part-time students complete the individual research project.
### ECTS assignments and Award requirements

<table>
<thead>
<tr>
<th>Course Element</th>
<th>Explanation of element components</th>
<th>Total Hours spent on Element</th>
<th>ECTS Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Papers</td>
<td>There are 4 written papers, each of 3 hours duration, taken at the beginning of the Summer term (normally the last week of April/first week of May). The marking scheme for the course awards a pass mark for each paper of 37.5% but to pass students must additionally obtain an aggregate across the 4 papers of 50%.</td>
<td>1008</td>
<td>40</td>
</tr>
</tbody>
</table>
| Coursework     | Coursework consists of the following items: literature review, laboratory reports, design study. The latter is a group activity whereas all other coursework is individual.  
  • Literature review: the literature review constitutes a written paper of about 5000 words and an oral presentation lasting 10 minutes. Guidance on the format of the written work is given separately. Students select a topic from a list supplied at the beginning of the academic session.  
  • Laboratory work: students conduct laboratory work in groups, but are required to submit individual reports. Four ‘short’ and four ‘long’ reports are required, the format for each type being given separately. Details of the current session’s laboratories are given in the Student Handbook for the course.  
  • Design study: students work on a defined task in groups of 4 or 5 students. There are regular progress meetings, at which oral presentations are made and progress reports submitted, and a final oral presentation and report. The latter will contain individual and group contributions.  
  The passmark for coursework (aggregate of the above separate items) is 50%. | 421                           | 16.5                         |
Research Project

The project constitutes a piece of individual research that for full-time students is a continuous activity from completion of the written papers (beginning of May) to the end of the course (third week of September). Some preparatory work (literature searching, project planning, assembling materials and test apparatus) is expected before the written papers (exams).

The project must include some element of originality and can be wholly experimental, wholly theoretical, or a mixture of the two. The results from the study must be set in context against published work.

The project is assessed by progress in conducting the work (including 4 end of month (May, June, July and August) progress reports), a dissertation of about 10,000 words, and an oral presentation (lasting 20 minutes). Guidance is given separately on the expected format of written work.

The passmark for the project is 50% (individually for the above separate items (progress, oral, dissertation).

---

Award Requirements
To be awarded the MSc students must pass separately, according to the criteria given above, each element of the examination (coursework, written papers and research project). Failure in one or more elements cannot be compensated by superior performance in other elements.

A ‘merit’ will be awarded if a score $\geq 60\%$ is obtained in each of the three elements and in the dissertation.

A ‘distinction’ will be awarded if a score $\geq 70\%$ is obtained in each of the three elements and in the dissertation.

---

<table>
<thead>
<tr>
<th>Research Project</th>
</tr>
</thead>
</table>
| The project constitutes a piece of individual research that for full-time students is a continuous activity from completion of the written papers (beginning of May) to the end of the course (third week of September). Some preparatory work (literature searching, project planning, assembling materials and test apparatus) is expected before the written papers (exams).

The project must include some element of originality and can be wholly experimental, wholly theoretical, or a mixture of the two. The results from the study must be set in context against published work.

The project is assessed by progress in conducting the work (including 4 end of month (May, June, July and August) progress reports), a dissertation of about 10,000 words, and an oral presentation (lasting 20 minutes). Guidance is given separately on the expected format of written work.

The passmark for the project is 50% (individually for the above separate items (progress, oral, dissertation). | 852 | 33.5 |

18. Support provided to students to assist learning (including collaborative students, where appropriate).

- Induction programme for orientation, introduction to library, information retrieval and information technology, and the Department.
- MSc Student Handbook.
- A large community of postgraduate research students and postdoctoral research workers who work in the general area of composite structures. The research programmes in the department provide general as well as specific support.
- Employer needs and opinions feed into the programme through guest lecturers from industry, student placements in relevant industries, industry-based projects and collaboration between academic staff and industry in research and consultancy.
- Library and other learning resources and facilities.
- Dedicated computing facilities.
- Many visiting speakers.

9 MSc in Composites
19. Criteria for admission:

The minimum qualification for admission is normally an Upper Second Class Honours degree in Engineering or Science from a UK academic institution or an equivalent overseas qualification, or a slightly lower academic qualification if backed up with relevant industrial experience. Where an applicant has a lesser degree qualification but has at least 3 years’ relevant work experience exceptionally the Course Director may make a special case for admission, possibly requiring the applicant to sit an entrance examination. Offers made to students are initiated by the Course Director.

20. Processes used to select students:

- Academic standard (including guidance from Registry in interpreting overseas grades) and CV data from application form
- 2 academic references
- Interview where possible

21. Methods for evaluating and improving the quality and standards of teaching and learning

a) Methods for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards:

The external examiner system and Boards of Examiners are central to the process by which the College monitors the reliability and validity of its assessment procedures and academic standards. Boards of Examiners comment on the assessment procedures within the College and may suggest improvements for action by relevant departmental teaching Committees.

The Faculty Studies Committees and the Graduate Schools’ Postgraduate Quality Committees review and consider the reports of external examiners and accrediting bodies and conduct periodic (normally quinquennial) and internal reviews of teaching provision. Regular reviews ensure that there is opportunity to highlight examples of good practice and ensure that recommendations for improvement can be made.

At programme level, the Head of Department/Division has overall responsibility for academic standards and the quality of the educational experience delivered within the department or division.

Accreditation of the course is being sought from the Royal Aeronautical Society and the Institution of Mechanical Engineers. Accreditation will provide additional assurance that the programmes is of the appropriate standard and relevant to the requirements of industry and the professions.

b) Committees with responsibility for monitoring and evaluating quality and standards:

The Senate oversees the quality assurance and regulation of degrees offered by the College. It is charged with promoting the academic work of the College, both in teaching and research, and with regulating and supervising the education and discipline of the students of the College. It has responsibility for approval of changes to the Academic Regulations, major changes to degree programmes and approval of new programmes.
The Quality Assurance Advisory Committee (QAAC) is the main forum for discussion of QA policy and the regulation of degree programmes at College level. QAAC develops and advises the Senate on the implementation of codes of practice and procedures relating to quality assurance and audit of quality and arrangements necessary to ensure compliance with national and international standards. QAAC also considers amendments to the Academic Regulations before making recommendations for change to the Senate. It also maintains an overview of the statistics on completion rates, withdrawals, examination irregularities (including cases of plagiarism), student appeals and disciplinaries.

The Faculty Studies Committees and Graduate School Postgraduate Quality Committees are the major vehicle for the quality assurance of undergraduate / postgraduate courses respectively. Their remit includes: setting the standards and framework, and overseeing the processes of quality assurance, for the areas within their remit; monitoring the provision and quality of e-learning; undertaking reviews of new and existing courses; noting minor changes in existing programme curricula approved by Departments; approving new modules, changes in module titles, major changes in examination structure and programme specifications for existing programmes; and reviewing proposals for new programmes, and the discontinuation of existing programmes, and making recommendations to Senate as appropriate.

The Faculty Teaching Committees maintain and develop teaching strategies and promote inter-departmental and inter-faculty teaching activities to enhance the efficiency of teaching within Faculties. They also identify and disseminate examples of good practice in teaching.

Departmental Teaching Committees have responsibility for the approval of minor changes to course curricula and examination structures and approve arrangements for course work. They also consider the details of entrance requirements and determine departmental postgraduate student numbers. The Faculty Studies Committees and the Graduate School Postgraduate Quality Committees receive regular reports from the Departmental Teaching Committees.

c) Mechanisms for providing prompt feedback to students on their performance in course work and examinations and processes for monitoring that these named processes are effective:

a. We endeavour to return marked coursework items to students within 2-3 weeks of the last submission date. This is managed by the teaching office who request, supported by the academic organiser, speedy return of marked coursework from staff. The feedback includes a form for each coursework item indicating the breakdown of marks across the assessment categories and written comments noting good features and areas which could be improved.

b. Examinations are held in April/May. After these (4-5 weeks usually) students are given guidance on an individual basis (we do not provide exact marks) by the academic course organiser on their performance. This feedback can be particularly encouraging for those students targeting ‘merit’ or ‘distinction’ grades.

c. The academic course organiser is always available for discussion with individual students on their performance

d) Mechanisms for gaining student feedback on the quality of teaching and their learning experience and how students are provided with feedback as to actions taken as a result of their comments:

- Staff – Student Committee.
- Course questionnaire evaluating overall course.
- Course questionnaire evaluation of modules.
- Students are provided with feedback on their comments either in a later staff-student committee meeting (in the same session) or by actions such as rescheduling a submission deadline.

e) Mechanisms for monitoring the effectiveness of the personal tutoring system:
• The academic course organiser acts as personal tutor to all students. Regular meetings are not scheduled but it is made clear to the students that he is available for consultation. The course organiser is not monitored by a higher authority but students can again approach the Head of Department if they prefer to do so.

f) Mechanisms for recognising and rewarding excellence in teaching and in pastoral care:

Staff members are encouraged to reflect on their teaching, in order to introduce enhancements and develop innovative teaching methods. Each year College awards are presented to academic staff for outstanding contributions to teaching, pastoral care or research supervision. A special award for Teaching Innovation, available each year, is presented to a member of staff who has demonstrated an original and innovative approach to teaching. Nominations for these awards come from across the College and students are invited both to nominate staff and to sit on the deciding panels.

g) Staff development priorities for this programme include:

• Staff to consider enhancement of lecture course content to incorporate growing new areas, to recognise the changing needs of industry and to include recent research advances.
• Endeavour to increase the number of external/industrial project placements since these are regarded as highly attractive by MSc students.

22. Regulation of Assessment

a) Assessment Rules and Degree Classification:

To be awarded the MSc students must achieve a mark of 50% or greater in each element of the examination (coursework, written papers and research project) and achieve a mark of 50% or greater in each of the assessment categories of the individual research project (progress, oral, dissertation). Failure in one or more elements cannot be compensated by superior performance in other elements.

A ‘merit’ will be awarded if a mark of 60% or greater is obtained in each of the three elements and in the dissertation.

A ‘distinction’ will be awarded if a mark of 70% or greater is obtained in each of the three elements and in the dissertation.

b) Marking Schemes for undergraduate and 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.

c) Processes for dealing with mitigating circumstances:

A candidate for a Master’s degree who is prevented owing to illness or the death of a near relative or other cause judged sufficient by the Graduate Schools from completing at the normal time the examination or Part of the examination for which he/she has entered may, at the discretion of the Examiners,

(a) Enter the examination in those elements in which he/she was not able to be examined on the next occasion when the examination is held in order to complete the examination,

or

(b) be set a special examination in those elements of the examination missed as soon as possible and/or be permitted to submit any work prescribed (e.g. report) at a date specified by the Board of Examiners concerned. The special examination shall be in the same format as specified in the course regulations for the element(s) missed.
Applications, which must be accompanied by a medical certificate or other statement of the grounds on which the application is made, shall be submitted to the Academic Registrar who will submit them to the Board of Examiners.

d) Processes for determining degree classification for borderline candidates:

For postgraduate taught programmes: Candidates should only be considered for promotion to pass, merit or distinction if their aggregate mark is within 2.5% of the relevant borderline. Nevertheless, candidates whom the Board deems to have exceptional circumstances may be considered for promotion even if their aggregate mark is more than 2.5% from the borderline. In such cases the necessary extra marks should be credited to bring the candidate’s aggregate mark into the higher range.

e) Role of external examiners:

The primary duty of external examiners is to ensure that the degrees awarded by the College are consistent with that of the national university system. External examiners are also responsible for approval of draft question papers, assessment of examination scripts, projects and coursework (where appropriate) and in some cases will attend viva voce and clinical examinations. Although external examiners do not have power of veto their views carry considerable weight and will be treated accordingly. External examiners are required to attend each meeting of the Board of Examiners where recommendations on the results of individual examinations are considered. External examiners are required to write an annual report to the Rector of Imperial College which may include observations on teaching, course structure and course content as well as the examination process as a whole. The College provides feedback to external examiners in response to recommendations made within their reports.

23. Indicators of Quality and Standards

- External examiners reports
- PG Periodic Review (last reviewed in 2014)

24. Key sources of information about the programme can be found in

- [http://www3.imperial.ac.uk/compositescentre/courses/msc/newstudents](http://www3.imperial.ac.uk/compositescentre/courses/msc/newstudents) provides online information for applicants together with further information from the Registry web link [http://www3.imperial.ac.uk/pgprospectus/howtoapply](http://www3.imperial.ac.uk/pgprospectus/howtoapply).

- For students on the course, a course handbook (available at [https://workspace.imperial.ac.uk/aeronautics/Public/MSc%20in%20Composites%20Programme%20Handbook%202014-15.pdf](https://workspace.imperial.ac.uk/aeronautics/Public/MSc%20in%20Composites%20Programme%20Handbook%202014-15.pdf)) is provided together with extensive detail on intranet links (e.g. course description, aims and objectives for each individual lecture course) for which password access is required. For most lecture courses electronic copies of the notes are provided on the intranet. Past exam papers plus model solutions are similarly available.