Programme Specification for the MSc in Sustainable Energy Futures

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/energyfutureslab/students/msc. 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: Not Applicable
4. Name of Final Award (BEng / BSc / MEng etc): MSc and DIC
5. Programme Title (e.g. Biochemistry with Management): Sustainable Energy Futures
6. Name of Department / Division: Energy Futures Lab
7. Name of Faculty: Engineering
8. UCAS Code (or other coding system if relevant): Not Applicable
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: Full Time
12. Language of Study: English

13. Date of production / revision of this programme specification: August 2012 (module list – point 17- revised November 2014)
14. Educational aims/objectives of the programme

The MSc in Sustainable Energy Futures is an interdisciplinary course, run by the Faculty of Engineering and involving various departments in the Faculties of Engineering, Natural Sciences and the Business School.

The course is designed to provide students with a challenging, intellectually stretching environment covering numerous interdisciplinary aspects of energy: technology, economics, policy, business and finance and their interrelations; theory and practical applications; a substantial interdisciplinary research project; contact with leaders from industry and other organisations; contact with leading

1 MSc in Sustainable Energy Futures
energy researchers within the College and elsewhere. Emphasis is on a whole systems approach and the use of quantitative analytical methodologies.

The programme aims/objectives are to:

• train the next generation of “energy savvy” graduates equipping them to pursue careers in, and make an impact on, the energy industry, the energy investment sector, the public sector and non-governmental organisations;
• provide students with knowledge for the recognition and understanding of the major features of the global energy issues, sustainable energy technologies and interactions with energy economics and policy;
• develop skills in methods of energy system analysis that allow this knowledge to be applied in practice;
• foster the acquisition and implementation of broad research and analytical skills related to sustainable energy;
• develop the skills needed to undertake independent research both in industry and in the university environment.

15. Programme Learning Outcomes

1. Knowledge and Understanding:

1. The major topics, facts and issues related to global energy demand and utilisation, key energy production, storage, transmission and utilisation technologies, key energy economics, environmental and policy issues, and their interdisciplinary nature.

2. The underlying scientific principles and computational methodologies for quantitative analysis and evaluation of the above aspects as part of complex energy systems, including sustainability aspects over their life cycle.

3. The application of quantitative analysis and evaluation methods for the solution of typical, practical energy systems problems.

4. Research techniques which might include information retrieval, experiment and data analysis, modelling, economic and environmental impact assessment, and ethical aspects of research, as required generating an independent piece of research.

5. Management and communication skills, including problem definition, project design, decision processes, negotiation, written and oral reports, scientific publications.

Acquisition of 1 to 3 is through a combination of formal classroom based teaching, practical classes, tutorials and seminars, in foundation courses in the autumn term and other more targeted modules in the Spring term.

Acquisition of 4 is through a combination of lectures and workshops, and independent project work (including the use of computer research and modelling tools) in the foundation courses and other modules, and utilised through a full-time, individual, supervised research project during April-September.

Acquisition of 5 is through a combination of lectures, workshops, seminars, independent project work, research reports and presentations and the full time research project.

Invited seminars provide students with first-hand knowledge of the topics covered as they apply in industry and commerce, and provide an excellent environment for interaction with professionals from the wider energy sector.

2 MSc in Sustainable Energy Futures
Students will receive feedback:

i) Informally, during course tutorials
ii) Via assessment of coursework project components of taught courses
iii) Via reports on performance of January and summer exams
iv) Via regular meetings with research project supervisors
v) By assessment of a research literature survey report.
vii) Via meetings with the course director and assistants as necessary.

2. Skills and other Attributes

Intellectual Skills:

1. Analyse and solve problems using a multidisciplinary approach, applying professional judgments to balance performance, costs, benefits, safety and social and environmental impact.

2. Integrate and critically evaluate information.

3. Formulate and apply appropriate solutions.

4. Plan, generate and complete a programme of independent research.

Analytical thinking and problem solving skills (1-4) are at the core of theory and case studies presented in lectures, practical project work, seminars and tutorials. This will provide ample opportunity for students to interact amongst themselves and with staff. Interaction with external leaders will be available in the Seminars course.

The acquisition of a systems view of problems will be stimulated by the interdisciplinary nature of the course and by research projects which are normally supervised by at least two supervisors.

Regardless of background, students will feel challenged: for science and engineering graduates many of the energy economics and energy policy concepts will be new; technical issues will have to be mastered in areas wider than those covered in their first degree. Students will need to relate theoretical concepts with demanding applications.

Practical Skills:

1. Retrieve and critically analyse basic data in respect of energy sources, production, transformation and demand.

2. Formulate complex energy problems involving aspects of efficiency, risk, environmental impact, and economics quantitatively, making relevant assumptions.

3. Have the theoretical awareness to be able to select and/or practically utilise a wide range of research methodologies and analysis techniques.

4. Use selected software tools to evaluate and solve individual and combined aspects for a range of complex energy systems problems.

5. Analyse results and make recommendations.

6. Prepare technical reports.

7. Give technical presentations.

8. Manage resources and time.
9. Use the scientific literature effectively.

Skills 1-3, 5 will be learned in the foundation courses in the autumn term, and reinforced through case studies discussed throughout the year, in tutorials, practical coursework components and in the seminars, and the generation of the dissertation.

Data sources and retrieval will be the subject of a practical workshop and tutorial exercises in the autumn term. Particular attention will be given (with the support of the Library staff) to briefing students on the use of on-line bibliographic resources to access primary sources (1, 9). Students will be required to attend three core transferable skills workshops offered by Graduate School. These should include the workshop on tackling a Literature Review. Use will be made of specialist software, for example for modelling and lifecycle analysis, in the teaching and coursework components of most courses (4), through coursework exercises and project work.

Transferable Skills:

1. Communicate effectively though written and oral presentations.
2. Work in groups and exercise interpersonal skills.
3. Bridge techniques and solutions from one discipline to another.
4. Understand complex processes that depend on the interplay of both technical and other aspects.
5. Learn to self-learn and gather information.
6. Develop entrepreneurship skills

The development of communications skills (1) will be addressed through written project work and research literature review reports, both assessed, the presentation of research in a poster and thesis dissertation. Oral presentation skills will be developed through a short workshop ahead of the formal presentation of results from the research project at the completion of the course.

It is envisaged that some project work will be carried out on a small group basis, which will also emphasise communication, negotiation, organisation and inter-personal skills (2).

Self-learning (5) will be stimulated through coursework projects, the need to substantially deepen the understanding of taught material through self study, and the independent research project, all of which include suitable feedback.

As the degree is a joint programme between various departments across the faculties of Engineering, Natural Sciences and the Business School there is an in-built interdisciplinary approach. The acquisition of a systems view of complex problems (3, 4) will thus be stimulated by the interdisciplinary nature of the entire course. It will also be reinforced by research projects being supervised by at least two supervisors from different departments.

Entrepreneurship skills are also part of the formal courses and will be further stimulated through case studies of successful energy start ups and interaction with the energy investment community as part of the seminars course.

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

Course Handbook

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

All students take three foundation courses in the autumn term, including Energy Systems Technology, Methods for the Analysis of Energy Systems, and Energy Economics and Policy. These provide a common basis, language and analytical toolkit to students from diverse backgrounds. They are followed by a set of more specialised modules, and a research project. Each course typically involves

4 MSc in Sustainable Energy Futures
elements of coursework, small projects and self study in addition to formal lectures. The foundation taught courses are complemented by seminars delivered by distinguished external leaders from industry, commerce and government. During the autumn term the students are also required to participate in the Energy Futures Debating Society and each is required to research and lead a debate in a current energy topic.

The foundation courses are delivered in parallel in the traditional, linear mode, while the specialist courses are a sequence of 6 intensive, one or two-week modules, all of which are compulsory. Students select a research project in the first term and present an initial literature review report (assessed) in the spring term, with the bulk of the research conducted in April-September. To emphasise the inter-disciplinarity of the MSc, research projects will each aim to have at least two supervisors from different departments.

To complement the formal teaching, students are required to attend six core transferable skills workshops offered by Graduate Schools. These are not examined, but are nonetheless mandatory.

This course structure was chosen so as to enable the development of exchange programmes with selected academic partners, whereby our students may spend some period at collaborating institutions and we may host their students (subject to agreement and mutual recognition). Similarly, some of our own modules may be taught at partner institutions, and invited guest lecturers will be able to deliver short courses here on special topics.

Taught Courses

Autumn Term: Foundation courses, Seminar course:
SEF01. Energy Systems Technology (35 hours)  6 ECTS units
SEF02. Methods for the Analysis of Energy Systems (35 hours)   6 ECTS units
SEF03. Energy Economics and Policy (35 hours)  6 ECTS units
SEF04. Seminars/Debating Society Course (20 hours)    2 ECTS units
SEF10. Entrepreneurship in Renewable Energy (36 hours)   5 ECTS units

Spring Term: 5 Courses:
SEF05. Urban Energy Systems (36 hours)     5 ECTS units
SEF06. Bioenergy (36 hours)       5 ECTS units
SEF07. Low Carbon Technologies (36 hours)     5 ECTS units
SEF08. Energy Transmission and Storage (36 hours)    5 ECTS units
SEF09. Sustainable Transport (36 hours)     5 ECTS units
Research Project:       40 ECTS units
Project selected in during the autumn term. A literature review report is presented in the spring term with the final dissertation due in early September.

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

- A dedicated course director and administrator.
- A short induction period to acquaint students with the course director and administrator, teaching staff and project supervisors and College support services/facilities such as the library.
- Student Information Pack – Course details, timetable, campus maps.
- MSc Course Handbook.
- A dedicated student course room with desks, PCs, break-out rooms and kitchen facilities.
- An on-line learning environment providing access to course notes, lecture slides and coursework assignment details.
- A student-staff committee comprising the course director, administrator and two elected student representatives.

5 MSc in Sustainable Energy Futures
• Two thesis project supervisors per student.
• Access to Graduate Schools courses/workshops.
• Access to general College student support services and to services provided by the Mechanical Engineering Department including:
  o Careers advisory service.
  o Safety officer.
  o Post graduate tutor.
  o Women’s tutor.
  o Student counselling service.

19. Criteria for admission:

The minimum qualification for admission is normally an Upper Second Class Honours degree from a UK academic institution (or an equivalent overseas qualification) in engineering or physical sciences. Consideration may also be given to excellent applicants with degrees in life sciences and economics where these included an adequate component of mathematics or candidates with extensive relevant post-degree experience.

For non-Anglophones there is a requirement to pass the TOEFL test with a minimum overall score of 100 and at least 24 in the writing and speaking components. Alternatively an IELTS overall mark of 6.5 with at least 6 in the writing and speaking components is acceptable. Equivalent qualifications may be considered.

20. Processes used to select students:

Students are normally selected on the basis of their College application form but may be invited for interview as required.

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 Teaching Committee and the Graduate Schools' Master's Quality Committees review and consider the reports of external examiners and conduct annual reviews of teaching provision and administrative processes. 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 Course Director has overall responsibility for academic standards and the quality of the educational experience delivered, and gives regular reports to the Principal of the Faculty of Engineering.

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 Strategic Education Committee includes representatives of academic staff and academic support services. The SEC has three Committees relevant to postgraduate courses reporting to it: the e-Learning Strategy Committee (e-LSC), the Graduate School Management and Strategy Committee and the Student Recruitment and Admissions Strategy and Operations Committee (SRASOC), which

6 MSc in Sustainable Energy Futures
also reports to the SRC. The SEC reports to the Management Board on high level, College-wide strategy on education, recruitment and the student experience, consulting with Imperial College Union (ICU) on relevant issues and promoting high quality external opportunities.

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.

The Faculty Teaching Committees and the Graduate School Master’s Quality Committees are the major vehicles for the quality assurance of undergraduate / Master’s 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/Institute Teaching Committees have responsibility for the day-to-day oversight of a Department’s programmes including the approval of minor changes to course curricula and examination structures and approval of arrangements for course work.

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:

Coursework submission dates are published in the student handbook along with the dates on which assessment will be completed and feedback provided. The course administrator monitors adherence to these dates and reports variations to the course director and courses committee.

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:

Students are invited to participate in surveys to enable student feedback on the College and its courses can be obtained and used to enhance provision. External surveys in which students participate include:

- Postgraduate Research Experience Survey (PRES)
- International Student Barometer (ISB)

Internal surveys include:

- PG SOLE (Master’s student online evaluation exercise)

A staff-student committee composed of the course director, administrator and two elected student representatives also meet on a termly basis.

e) Mechanisms for monitoring the effectiveness of the personal tutoring system:

Not Applicable.

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

7 MSc in Sustainable Energy Futures
Staff 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:

Not Applicable.

22. Regulation of Assessment

a) Assessment Rules and Degree Classification:

The Pass Mark for each component of the Master’s programme is 50%. For the assignment of a degree classification the programme is deemed to comprise two elements. One for which the mark is the total obtained from taught modules and a second comprising the individual research project. In order to be awarded a result of merit, a candidate must obtain an aggregate mark of 60% or greater in both elements; a result of distinction requires an aggregate mark of 70% or greater in both elements.

Further information is available in the Academic and Examination Regulations

The marking scheme for this programme is available in the course handbook.

b) Processes for dealing with mitigating circumstances:

The College’s Extenuating Circumstances Affecting Academic Performance: Policy and Procedures makes provision for Boards of Examiners to use their discretion where extenuating circumstances are independently corroborated and are judged by the advisory panel to be of sufficient severity to have substantially affected performance.

c) Processes for determining degree classification for borderline candidates:

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. Detailed records of all decisions should be recorded in the minutes of the meeting of the Board.

d) Role of external examiners:

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. External examiners’ primary duties are to ensure that the standard of the College’s degrees is consistent with that of the national sector; to ensure that assessment processes measure student achievement rigorously and fairly and that the College is maintaining the threshold academic standards set for its awards in accordance with the frameworks for higher education qualifications and applicable subject benchmarks statements. External examiners gather evidence to support their judgement through the review of course materials, approval of draft question papers, assessment of examination scripts, projects and coursework, and in some instances, through participation in viva voce and clinical examinations. External examiners are members of Boards of Examiners and participate in the determination of degree classifications and student progress.

External examiners submit their reports to the Rector and President. The reports are scrutinised by the Pro-Rector (Education) and by the Registry QA team to identify any points of concern. These are then referred to the Director of Education and Chairman of the Board of Examiners, with a request to comment on the points raised and to explain how any concerns will be addressed. The reports and
Departmental/Institute comments are subsequently considered by the relevant Faculty Teaching Committee or Graduate School MQC, which may seek further assurances from a Department/Institute on the resolution of a particular problem. The committees will also consider examples of good practice raised by the external examiners. Following consideration of the reports, the Registry provides feedback to external examiners. From 2011-12 external examiner reports, and the departmental/Institute responses to them, are available on the College's intranet.

23. Indicators of Quality and Standards:

It is envisaged that the following quality indicators will be monitored and used to improve the course:
- Comments by External Examiners.
- Regular reviews by the Graduate School Management Committee.
- Student survey at the end of the course.
- Completion rate, employment record and destination of graduates.

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

This specification provides a concise summary of the main features of the programme and learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if she/he takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the course handbook. The accuracy of the information contained in this document is reviewed by the College and may be checked by the Quality Assurance Agency for Higher Education (QAA). Additional details about this course can be obtained from:

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