Programme Specification for the Masters in Petroleum Engineering

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://www.imperial.ac.uk/earthscienceandengineering/courses/postgraduatedcourses/mscpetroleumengineering. 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
5. Programme Title (e.g. Biochemistry with Management): Petroleum Engineering
6. Name of Department / Division: Earth Science and Engineering
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
10. Level(s) of programme within the Framework for Higher Education Qualifications (FHEQ):

<table>
<thead>
<tr>
<th>Level(s)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Bachelor’s (BSc, BEng, MBBS)</td>
<td>Level 6</td>
</tr>
<tr>
<td>Integrated Master’s (MSci, MEng)</td>
<td>Levels 6 and 7</td>
</tr>
<tr>
<td>Master’s (MSc, MRes)</td>
<td>Level 7</td>
</tr>
</tbody>
</table>

11. Mode of Study
Full-time

12. Language of Study: English

13. Date of production / revision of this programme specification (month/year):
August 2012

14. Educational aims/objectives of the programme
The programme aims/objectives are to:

1. MSc Petroleum Engineering
The objective of the MSc curriculum is to train petroleum engineering professionals that understand the work flow concepts that are now prevailing in the oil industry and therefore are fully prepared to work in multi-disciplinary teams. The MSc curriculum, organised around five teaching modules, is intended to give students a full understanding of:

(1) the fundamental concepts of reservoir characterisation, reservoir modelling, reservoir simulation, and field management;
(2) the links between the various types of data; and
(3) the processes for integrating and processing all available information.

15. Programme Learning Outcomes

1. Knowledge and Understanding

Knowledge and Understanding of

- reservoir characterisation
- reservoir modelling
- reservoir simulation
- field management
- the links between the various types of field data
- the processes for integrating and processing all available information in order to make better reservoir management decisions.

Teaching/learning methods and strategies

- Formal lectures, problem classes, laboratory and computer exercises. These take place on a full-time, structured basis from October to March in the normal academic terms. During the taught course, our students are taken on field trips including Wytch Farm, Dorset. Formal examinations are conducted in the first week of term in January and the first week of the Summer term.
- Group project work. This is a group exercise carried out by groups of about five to six students and involving an integrated study of the evaluation and development of part of a licence block (usually in the UKCS). The objective is to inter-relate separate subjects taught in formal lectures: characterisation, drilling, well and reservoir optimisation, the design of surface facilities, economic forecasting and application to regulatory authorities. Data for the project are analysed with the latest industry prevailing commercial software as part of Modules II to IV and integrated into a development proposal as part of Module V. The petroleum geoscience, petroleum geophysics and petroleum engineering MSc students cooperate closely, the objective being to create a common culture enabling professionals from the various disciplines to understand their own potential contribution, particularly to the reservoir characterisation process, as well as that of others. To that end, the reservoir characterisation phase of the group project is carried out in multidisciplinary groups, which reproduce the make-up of an asset team. The project is assessed initially by a presentation to the examiners at the end of the Spring term. After review and discussion, selected groups make further presentations to an invited audience from industry.
- Individual research projects. After formal examinations at the end of April, students work on individual research type projects. These are submitted at the beginning of September and are examined both as a report and by an oral presentation to an industrial audience in mid-September. Projects may be selected by the candidate, planned in cooperation with industrial sponsors or allocated by the Department. Assessment of the candidates is based on two separate considerations:
  - Examinations. All candidates take five 3-hour examinations on the subjects covered during the course. These account for 60% of the examination marks. The group project report (20% of the examination marks) is assessed with allocations of marks for the oral presentations and effort given to the group by the student.
  - Laboratory reports account for the remaining 4% of the examination marks.

1.MSc Petroleum Engineering
• Tutorials assigned during the taught part of the course account for 16%
• Individual research projects. Individual research projects are assessed by a report, a poster and a presentation of 20 minutes (plus 10 minutes for questions) to the examiners and representatives from the oil industry.

2. Skills and other Attributes

Intellectual Skills
Able to:
• Interpret and develop models from uncertain information
• Operate effectively as petroleum engineer

Teaching/learning methods and strategies
All these practical skills are taught in the formal lectures and through projects with actual field data.

Practical Skills
• The obtaining of oil from an oil reservoir - a quantitative demonstration of porosity, permeability, relative permeability, entrapment etc. by means of a sand-pack (related to Geology and Rock Properties course 1.5.1)
• Porosity and permeability determinations - a demonstration of the processes and difficulties involved in measuring these parameters (related to Geology and Rock Properties course 1.5.1)
• Rock resistivity - shows the basic principles of rock resistivity using saline solutions (related to Geology and Rock Properties course 1.5.1)
• 2-Phase Flow - a study of horizontal, vertical and inclined 2-phase flow patterns (related to Production Engineering course 3.1-3.4 and Process Engineering course 5.1)

Teaching/learning methods and strategies
All these practical skills are carried out in labs.

Transferable Skills
To enable students to communicate with industrial colleagues and to be aware of the latest developments in the industry. All students will give a talk as part of the Group Project in the Autumn and Spring terms.

Teaching/learning methods and strategies
• A number of lectures will be given by visitors from the Industry and Government Institutions on aspects of Petroleum Engineering covering current industrial problems and practice, within each teaching module.

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

Student Handbook (for Course approved by Senate of Imperial College)

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

Year One:
1.MSc Petroleum Engineering
Term one:
Module 1 - Fundamental Knowledge

Basic Petroleum Geology (15 hours)
- Introduction to the basic fundamentals of geology.
- Influence of Geologic Characteristics on Appraisal and Development
- Depositional Controls
- Pore Space Properties
- Aquifer Characterisation
- Reservoir Zonation and Thickness Mapping
- Reservoir Characterisation and Geological Modelling

Basic Petroleum Geophysics (6 hours)
- Seismic wave types
- Factors affecting seismic velocity
- Layer properties
- The convolutional model of the earth
- Seismic resolution
- Migration

Rock properties (9 hours)
- Porosity, Saturation, Permeability, Capillary pressure and pore size distributions
- Wettability
- Relative permeability and fractional flow
- Electrical and acoustic properties

Geological Field Trip (four and one half days)

Reservoir Fluids (12 hours)
- Nomenclature and units
- Reservoir, separator and surface conditions
- Hydrocarbon thermodynamics
- Classification of reservoirs
- PVT and phase behaviour of reservoir fluids
- Physical properties of liquids
- Gases

Hydrocarbons in-place and Reserves (3 hours)
- Reserve definitions and guidelines
- Volumetric derivation of hydrocarbons in-place
- Assessment of recovery factor
- Risk and uncertainty in resource estimation
- Deterministic and Probabilistic Methods

Flow In Porous Media (21 hours)
- Diffusivity Equation
- Line-Source solution
- Build-up, Multi-rate flow tests and superposition in time
- Linear boundaries and superposition in space
- Inner and Outer boundary conditions
- Advanced mathematical methods
- Flow of gases in porous media
- Multi-phase flow

Module 2 - Reservoir Characterisation
Production Mechanisms (3 hours)
- Primary and improved oil recovery
- Reservoir drives and production mechanisms
- Recovery factors

Petrophysics (36 hours)
- Coring: Coring and core analysis
- Routine (RCAL) and special core analysis (SCAL); sampling strategy; sample screening and preparation; validity of samples and tests; correlations; application of data in reservoir calculations
- Log analysis: borehole environment, invasion and resistivity profiles
- Electrical, Nuclear and Sonic logs
- Porosity, lithology, saturation and permeability estimation
• Practices and pitfalls of formation evaluation

**Well Testing (36 hours)**
• Interpretation model
• Identification, verification and mathematical representations
• Well test interpretation techniques (straight-line, pressure log-log and pressure derivative analyses)
• Near wellbore effects, reservoir behaviours, outer boundaries
• Gas wells
• Multiphase flow
• Special tests
• Test design

**Practical considerations**

**Fluid sampling and analysis (9 hours)**
• Laboratory measurement of PVT
• Good sampling procedures
• Volatile oils
• Other properties - pour point, wax, asphaltenes, hydrates

**Production logging (9 hours)**
• PLT applications
• In-situ calibration
• Analysis of spinner response in single phase flow
• Temperature log applications
• 2-phase flow regimes
• PNL applications and interpretation methods
• Responses in horizontal wells

**Integration into reservoir model (15 hours)**
• Geostatistics
• Object-based and Pixel-based models for reservoir characterisation
• Multidisciplinary data integration
• The Do’s and Don’t's of uncertainty quantification

**Uncertainties from Static to Dynamic (12 hours)**

**Group Project: Reservoir Characterisation Phase (3 weeks)**
• STOIIP
• Reserve estimates
• Preliminary 3D model

**Examinations**
The students take 2 written papers in early January on:
Rock Properties and Reservoir Fluids (3 hour paper)
Well Testing and Flow in Porous Media (3 hour paper).

There are also take-home assignments in:
Petroleum Geology
Petrophysics
These are marked and part of the MSc assessment. Their purpose is to give students a guide to their own progress, especially for those who have returned to study after a period in industry and for our overseas students to familiarise themselves with our examination procedures.

There are also take-home homeworks in most of the lectures. These are assessed and used as evidence of progress and of the student’s understanding of the course. They also test elements of numeracy and written communication skills.

Term 2

**Module 3 - Well Performance**

**Well Construction (Drilling and Completion (18 hours))**
• Oilfield drilling
• Well engineering
• Well design
• Drilling safety

1.MSc Petroleum Engineering
• Completing wells
• Production

**Production engineering/well performance (27 hours)**
• Flow of fluids into the wellbore
• Single and multi-phase fluid flow in pipes
• Productivity Index (PI) and Inflow Performance Relationships (IPR) for oil and gas wells
• Nodal analysis
• Gas condensate wells
• Complex wells
• Well deliverability for oil and gas wells
• Artificial lift systems

**Module 4 - Reservoir Performance**

**Reservoir performance prediction (33 hours)**
• Material Balance: Conservation of mass and volume
• Gas reservoirs
• Oil reservoirs
• Accuracy of material balance equation
• Fluid displacement models: Immiscible displacement calculations
• Recovery factor
• Microscopic, vertical and areal sweep efficiencies
• Stratified reservoirs
• Decline curves: Exponential, hyperbolic, Fetkovich decline curve analysis. Ranges of validity

**Streamline simulators**

**Numerical Simulators (21 hours)**
• Reservoir models
• Equations and terminology
• Simulation models
• Grid systems
• Rock properties
• Model relative permeability
• Model capillary pressure
• Fluid properties and experiments
• Model fluid properties
• Aquifer treatment
• Model well and production data
• Tutorials

**Economics (18 hours)**
• Capex and Opex
• Future Cash Flows
• Measures of Financial Performance
• Effects of Phased and Incremental Projects
• Leasing and Outsourcing
• General Frameworks for Taxation
• Probabilistic and Monte-Carlo models
• Decision theory and Criteria
• External Financing and Loans
• Futures Markets

**Upscaling (9 hours)**
• Requirements for upscaling
• Upscaling of scalar properties and two-phase
• Limitations
• Validation of upscaled model and best practice

**Practical Use of Simulators**
• Eclipse features
• File organisation and structure
• Grids
• Fluid properties
• Rock properties
• Wells
• Aquifer modelling
- History matching
- Prediction

**Group Project: Well Placement and Production Optimisation Phase (1 week)**
- simulation model
- optimized well placement plan
- oil recovery
- cumulative oil production
- optimized well design
- artificial lift options
- a drilling plan
- casing design

**Module 5 - Field Development**
**Process engineering/surface facilities (27 hours)**
- Introduction To Surface Operations
- Fluid Separation
- Equilibrium Flash calculations
- Processing and conditioning of gas condensates and natural gases
- Hydrocarbon transportation and storage

Health, safety and environment (6 hours)
- Occupational safety and health
- Legal and administrative aspects
- Hazard identification and assessment
- Managing for safety
- Piper-Alpha tragedy and the Cullen Report
- Abandonment issues

**Group Project: Development Plan Phase (2 weeks)**
- improved recovery plan
- surface production facilities
- HSE plan
- economic viability
- abandonment plan
- assessment of risks

The students take 5 written examination papers, all of 3 hours in:

Rock Properties and Reservoir Fluids
Well Testing and Flow in Porous Media
Well Production and Optimisation
Reservoir Mechanics and Secondary Recovery
Process Engineering

plus assessed assignments in specific topics, such as:
Basic Petroleum Geology
Production Mechanisms and IOR
Drilling, Well Completions and Production Problems
Numerical simulators
Petroleum Economics

All papers are double marked and available for inspection by the external examiner. Individual staff examiners mark initially to their own scheme but the marks are reported to the MSc course Director. The Director then collates all the marks. The marks are then totalled according to the current weighting scheme. These 'averaged' marks determine the ranking of the student. It is these marks that are reported to the University to be given to the candidates.

Those with an average of above 70% with no exam marks below 60% are given the unofficial award of "commendation in examinations". Those that fail one or two papers maximum, but have an average of 50% or above at the exams, will after discussion at the examiners' meeting, be given an oral, with perhaps further written work. Those that fail the oral, or have failed one or more papers and have an average of less than 50% at the exams will have their degree deferred until they re-sit the failed papers the following year. If they then pass, they will be placed in the examination pass list for that year. It should be noted that minimum passes in all subjects is not necessarily regarded as an examination pass for the MSc.
The major papers (Fundamental knowledge; Reservoir characterisation; Well and reservoir performance; Field development) are closed book examinations. The formulae needed that are difficult to remember or correlation graphs are provided when appropriate. The questions are typically the hand calculations carried out in the industry to check computer estimations and many questions are derived from real field data. We believe this method of examining gives the student the proper technical preparation for industry employment. The testing of understanding is demonstrated in the field project.

**Term Three:**

**The Individual project**
End of February area of interest is defined;  
End of March specific topic and general objectives defined  
Mid-May start project after the end of examinations;  
End of May project review - a 10-minute presentation that highlights objectives, approach and plan for the Project;  
June-July-August short progress forms sent to College;  
Early September submission of draft report  
Mid September preparation of poster on project, handing in of written dissertation (10000-15000 words plus figures, diagrams etc.) followed by oral examination in front of Academic Staff and Industry visitors.  
Late September submission of final report for binding  
The individual projects are assessed by a report, a poster and a presentation of 15-20 minutes (plus 10 minutes for questions) to the examiners and representatives for the oil industry. The reports are read by two examiners. The candidates are awarded "commendation for project work" for a mark over 70%, a pass for marks between 50-70%; a fail below 50%.

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

- One week induction programme for orientation, introduction to library and computer facilities  
- MSc Student Handbook, which includes lecture timetable and practical protocols  
- A large community of postgraduate research students and postdoctoral research workers  
- A comprehensive seminar programme  
- Library and other learning resources and facilities at the South Kensington Campus.  
- Dedicated computing facilities  
- Safety lecture given in first week core programme.  
- Students conducting their research projects at an external site are assigned a member of Imperial College academic staff to oversee progress and advise on the project dissertation. Where practical, students will be visited by College staff during their project.  
- Student email and open personal access to tutorial staff including the Course Director.  
- Access to student counsellors on the South Kensington site.  
- Access to Teaching and Learning Support Services, which provide assistance and guidance, e.g. on careers.  
- Opportunities for students to conduct their research projects at a wide range of external companies.  
- Employer needs and opinions feed into the programme through frequent guest lecturers from industry and possible student placements in industry-based research projects.

**19. Criteria for admission:**

The minimum entrance qualification is a first class honours degree in science or engineering from a UK university or its equivalent from an overseas academic institution. Professionals with other qualifications, but with a minimum of three years relevant industrial experience, are also encouraged to apply.  
All students for whom English is not a native language will need to demonstrate good command of spoken and written English. The College will normally accept students with a TOEFL score of at least 600, or an IELTS score of at least 6.5.

1.MSc Petroleum Engineering
20. Processes used to select students:
   - Review of application form

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.

Most of the College’s undergraduate programmes are accredited by professional engineering and science bodies or by the General Medical Council. Accreditation provides the College with additional assurance that its programmes are of an appropriate standard and relevant to the requirement of industry and the professions. Some postgraduate taught courses are also accredited.

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:

Returning of results from homeworks, Team meetings during field development projects and general feedback on the individual phases of the group project through a presentation at the end of each phase. Feedback and comments from the markers of the presentations are also provided in written format to the groups. Individual meetings during the individual project with their supervisor. The Course Director also meets each student on an individual basis at least once during the year to discuss progress on the course.

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:

- course questionnaire evaluation of taught components after each module;
- meeting of individual students with course organisers to discuss exams, research project and career aims;
- viva with External Examiner
- staff/Student committee carried out at least once per year.

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

N/A

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

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:

active research programme in Petroleum Engineering and Rock Mechanics
• staff appraisal scheme and institutional staff development courses;
• updating professional and IT/computing developments.

22. Regulation of Assessment

a) Assessment Rules and Degree Classification:

For undergraduate programmes classification of degrees will be according to the following range of marks:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Marks</th>
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<tbody>
<tr>
<td>First class</td>
<td>70 - 100%</td>
</tr>
<tr>
<td>Second class (upper division)</td>
<td>60 - 69.9%</td>
</tr>
<tr>
<td>Second class (lower division)</td>
<td>50 - 59.9%</td>
</tr>
<tr>
<td>Third class</td>
<td>40 - 49.9%</td>
</tr>
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</table>

1.MSc Petroleum Engineering
For *postgraduate taught programmes*: The Pass Mark for postgraduate taught courses is 50%. In order to be awarded a result of merit, a candidate must obtain an aggregate mark of 60% or greater; a result of distinction requires an aggregate mark of 70% or greater.

Where appropriate, a Board of Examiners may award a result of merit where a candidate has achieved an aggregate mark of 60% or greater across the programme as a whole AND has obtained a mark of 60% or greater in each element with the exception of one element AND has obtained a mark of 50% or greater in this latter element.

Where appropriate, a Board of Examiners may award a result of distinction where a candidate has achieved an aggregate mark of 70% or greater across the programme as a whole AND has obtained a mark of 70% or greater in each element with the exception of one element AND has obtained a mark of 60% or greater in this latter element.

b) **Marking Schemes for undergraduate and postgraduate taught programmes:**

The Pass Mark for all *undergraduate* modules is 40%. From October 2008 entry all undergraduates are required to pass all their course units to progress to the next year.

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:**

For *undergraduate programmes*: Candidates with mitigating circumstances are not subject to the borderline restrictions but should be considered individually. However, as a general principle, candidates whose marks are more than 5% below the borderline should not normally be raised to the next higher classification. Where the Board of Examiners determines that a higher classification should be awarded extra marks should be applied to bring the final marks into the higher range.

For *postgraduate taught programmes*: 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 *undergraduate programmes*: Candidates who fall no more than 2.5% below the minimum mark for a higher honours classification shall be eligible for review of their final classification; this review could include an oral examination or practical test or other mechanism appropriate to the discipline. Candidates whose marks are below the 2.5% borderline may be considered for a higher honours classification where certain provisions apply. Where the Board of Examiners determines that a candidate should be awarded a higher honours classification extra marks should be applied to bring their final marks into the higher range. Detailed records of all decisions should be recorded in the minutes of the meeting of the Board.
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**

First destination data for MSc graduates, showing a high proportion find employment with major oil and gas companies (60%), major oil service companies (30%) and oil and gas consulting companies (10%).
• Received leading scores in the most recent independent review of the quality of the educational provision by the Quality Assurance Agency

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

Postgraduate Prospectus, Imperial College London (available on-line http://www.imperial.ac.uk/P1212.htm)  
• MSc in Petroleum Engineering  
http://www3.imperial.ac.uk/earthscienceandengineering/courses/postgraduatecourses/mscpetroleumengineering  
• QAA Subject Review Report Imperial College of Science, Technology & Medicine  
http://www.qaa.ac.uk/reviews/reports/instReports.asp?ukprn=10003270