**CONFIDENTIAL**

# EXAMINERS' REPORTS 2013

## MATERIALS SCIENCE (MS)
## MATERIALS, ECONOMICS & MANAGEMENT (MEM)

## REPORT ON PRELIMINARY EXAMINATION IN MATERIAL SCIENCE

**Part I**

**A. STATISTICS**

| Category | Number | | | Percentage | | |
|---|---|---|---|---|---|---|
| | 2012/13 | 2011/12 | 2010/11 | 2012/13 | 2011/12 | 2010/11 |
| Distinction | 10 | 6 | 13 | 29 | 23 | 38 |
| Pass | 21 | 20 | 20 | 62 | 77 | 59 |
| Fail | 3 | 0 | 1* | 9 | 0 | 3 |

* Passed the resit in September

**Marking of scripts**

Scripts are single marked except for borderline cases which are double-marked.

**B. NEW EXAMINING METHODS AND PROCEDURES**

This year, the course lecturers suggested questions, with supporting model answers.

**C. Please list any changes in examining methods, procedures and conventions which the examiners would wish the faculty/department and the divisional board to consider.**

Following approval from Faculty for course lecturers to provide draft questions, the moderators would urge all course lecturers to submit corresponding model answers, noting how useful it was to have these for determining the complexity of the questions and for marking. In addition, noting that some candidates answered more questions than was necessary, the moderators recommend that consideration be given to formally advising candidates how the marking is normally addressed when more than the prescribed number of questions is answered.

**D. Please describe how candidates are made aware of the examination conventions to be followed by the examiners**

Circulation by Deputy Administrator (Academic) to all students and tutors by e-mail, hard copy, and onto the Departmental website.

A copy of the conventions for this examination is attached below.

**Part II**

**A. GENERAL COMMENTS ON THE EXAMINATION**

34 students were registered for the examination.

30 candidates passed all papers, without the necessity for compensation; one candidate was awarded a compensated pass (in MMES). Of the total of 31 successful candidates in June, 10 were awarded Distinctions, all with marks of 77% or more (rounded). This relatively high number of distinctions reflected what the Moderators saw as a strong set of scripts. On the other hand, although the number of students who passed is in line with previous years, this year there was a higher number of students who failed, 3, excluding another 3 who withdrew before the Prelims.

The prize for the best overall performance in Prelims was awarded to Katherine Danks of Mansfield College. The prize for the best performance in 1$^{st}$ year Practicals was awarded to Sarah Hopkin, of Trinity College. Additional prizes for outstanding performance were awarded to Frederick Faulkner of St Anne's College and Bruno Marco Dufort, also of St Anne's College.

## B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER

Where approved by the Proctors, 5 candidates were allowed (i) extra time on account of dyslexia / dyspraxia, and/or (ii) other special arrangements. These allowances seemed satisfactory.

**Gender Issues:**

Of the 34 candidates 10 were women and 24 men.

3 of the 10 distinctions were awarded to women.

In view of the small overall number of candidates, it is not sensible to draw conclusions from these data. The mean score for males was 69.3 and for females 69.9.

## C. DETAILED NUMBERS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

All candidates took the same papers for the whole examination.

## D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

Attached.

## E. COMMENTS ON THE PERFORMANCE OF IDENTIFIABLE INDIVIDUALS AND OTHER MATERIAL WHICH WOULD USUALLY BE TREATED AS RESERVED BUSINESS

One medical certificate was received and considered by the Moderators when reviewing the final results; [redacted]

| | | | | |
|---|---|---|---|---|
| [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

## F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

Dr P.A.J. Bagot
Dr S. Lozano-Perez (Chairman)
Dr M.P. Moody
Dr J.R. Yates

**Attachments**: Examination Conventions 2012/13
Comments on Materials Science 1: Structure of Materials
Comments on Materials Science 2: Properties of Materials
Comments on Materials Science 3: Transforming Materials
Comments on Maths for Materials and Earth Scientists

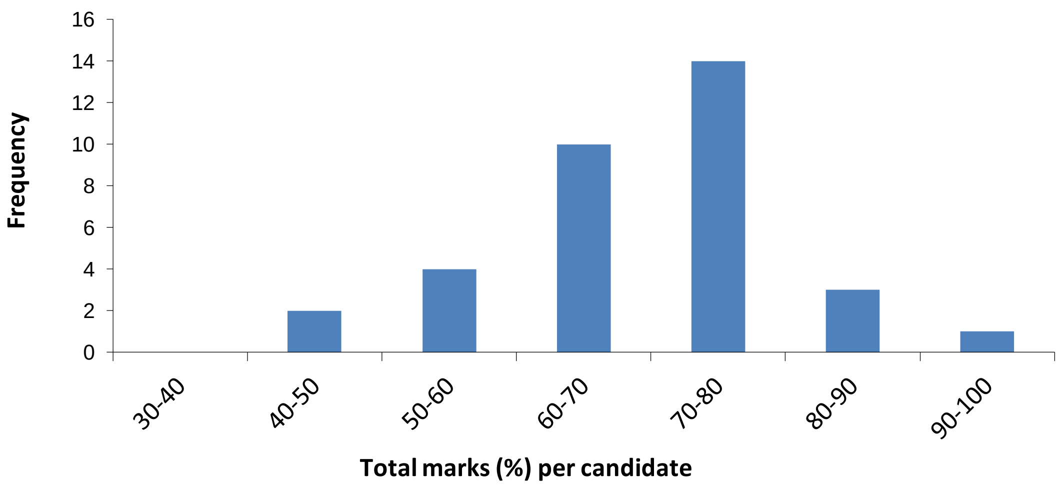
## MS1 – Structure of Materials

**Examiner:** Dr Sergio Lozano-Perez
**Candidates:** 34
**Mean mark:** 70.00%
**Maximum mark:** 91%
**Minimum mark:** 46%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|---|
| 1 | 11 | 10.82 | 17 | 2 |
| 2 | 11 | 9.55 | 18 | 5 |
| 3 | 12 | 11.25 | 16 | 4 |
| 4 | 32 | 13.59 | 19 | 8 |
| 5 | 31 | 15.45 | 19 | 9 |
| 6 | 32 | 16.03 | 20 | 4 |
| 7 | 13 | 15.46 | 18 | 12 |
| 8 | 28 | 14.04 | 19 | 7 |

**Prelims 2012/13**
**Materials Science 1**



**General comments:**

1. Questions 1-3 were the least preferred choices for the students. They all included the Crystallography questions. The average marks were slightly above 10. Although the questions were not too demanding, they were not popular

2. Question 4, on the other hand, was one of the most popular, and it was chosen by 32 students. The average mark was over 13 and there quite a few high-scorers. The students were asked to explain basic metallurgy concepts, comment on a particular solid solution curve and expand on the solubility of C in Fe. Many students felt comfortable with these topics.

3. Question 5 was also very popular, with 31 takers. The average mark was very good, over 15 marks. Students were asked to explain the types of bonding, expand on a type of ionic bonding and comment on the structure of NaCl, all very affordable topics.

4. Question 6 was attempted by 32 students, with an average mark of 16 (the highest). They were asked to describe some common defects in crystals, dislocation characterization methods and to explain a key concept in materials defects: Frank-Read sources.

5. Question 7 was attempted only by 13 students, but all who tried did relatively well, since the minimum mark was above 13. As in previous years, Polymers was not a very popular choice. Students were asked to describe the properties of different types of polymers, expand on composite matrices and describe ways of controlling bond strength. They all did well in most sections.

6. Question 8 was attempted by 29 students with an average mark of 14. In the first section, students were asked to describe one of the key experiments in quantum physics (Double slit), but very few seemed to realized that this experiment demonstrates both the wave and particle character of electrons. Some descriptions were very poor. The rest of the questions were better answered, in particular the one where they were asked to use molecular orbital diagrams.

**Summary:**

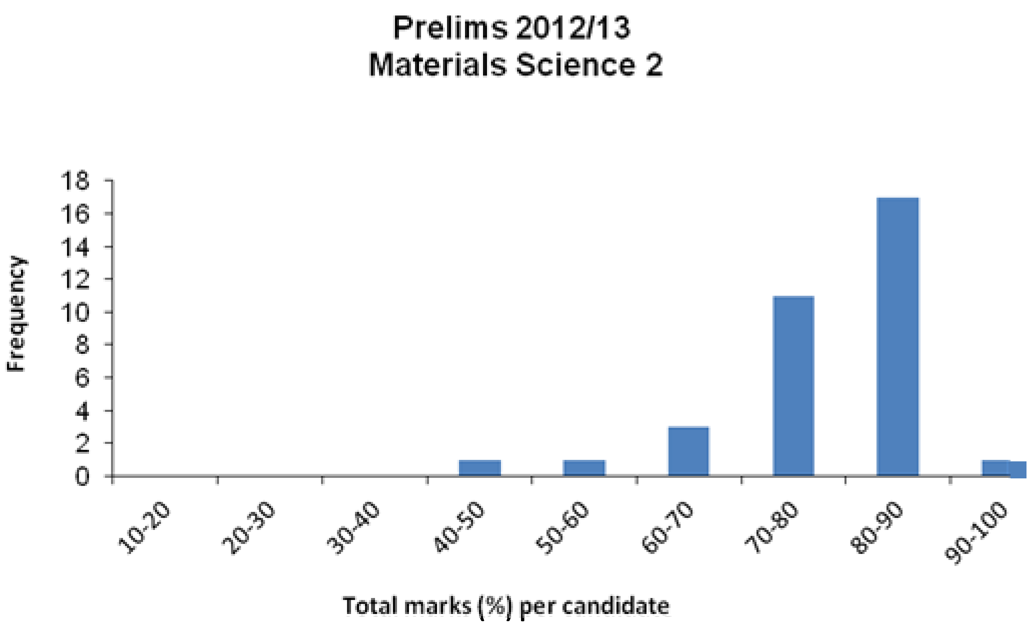
As in previous years, a general preference for questions who involved explaining and describing as opposed to analytically solving or calculating was observed. This year however, these two types of questions were adequately balanced, so only a decrease in performance was observed in the analytical questions. Once again generalized low marks were found in the Crystallography questions, which indicate a worrying lack of knowledge in the area by most of the students who chose to answer the questions in the exam.

## MS2 – Properties of Materials

**Examiner(s):** **Dr Michael Moody**
**Candidates:** **34**
**Mean mark:** **78.59%**
**Maximum mark:** **92%**
**Minimum mark:** **41%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|---|
| 1 | 30 | 12.77 | 19 | 7 |
| 2 | 32 | 17.63 | 20 | 8 |
| 3 | 5 | 14.60 | 19 | 11 |
| 4 | 2 | 10.50 | 15 | 6 |
| 5 | 34 | 16.62 | 20 | 3 |
| 6 | 19 | 14.16 | 18 | 8 |
| 7 | 19 | 16.32 | 20 | 10 |
| 8 | 29 | 16.79 | 20 | 3 |



## General Comments

1. **Elasticity and Structure:** The question required knowledge of transformation of axes resolving strain to an inclined axis, Mohr's circle for strain and principal strains. This was a popular question. A significant amount of marks lost was due to incorrect or incomplete illustration of the requested sketches.

2. **Elasticity and Structure:** The question required calculation of shear force and bending moments. It was a popular question and in general very well answered.

3. **Electrical and Magnetic Properties**: An unpopular question. It was a well-structured question, starting with fundamental understanding of electric fields and building in difficulty, incorporating magnetism and capacitance. The level of the question seems reasonable and this is supported by the average mark of those who attempted it, suggesting it was this part of the course in general being avoided and not just this specific question.

4. **Electrical and Magnetic Properties**: Even more unpopular than Question 3, only attempted by two candidates. The question addressed the induction of *emf* by a rotating loop in a magnetic field. Like question 3, this question started with some fundamental definitions, was well structured with increasing difficulty.

5. **Mechanical Properties**: Most popular question. The question was based around an understanding of slip and in particular Schmid's law. In general all parts of this question were well answered.

6. **Mechanical properties** A question that made the candidate consider aspects of the fundamentals of fracture mechanics, and the Griffith model.

7. **Kinetic Theory of Gases**: First part of the question, assumptions of the kinetic theory of gases, was correctly answered by nearly every candidate that attempted this question. However candidates had significantly more difficulty with the derivation required for the final part of the question.

8. **Mechanical Properties**: A popular question on the different stages of slip in different crystal systems. In general it was a very well answered question.

### General comment:

The mean mark was very high this year and in four of the questions at least one candidate was able to obtain full marks. It is clear that candidates well prepared for certain types of questions.

The most commonly answered questions were related to the mechanical properties of materials. Of these, Questions 5 and 8 covered quite similar areas and were both popular and very well answered. The questions on Electrical and Magnetic Properties were unpopular. However, it is my opinion that these questions were appropriate and fair. It would be good to consider if in future the exam could be structured to encourage candidates to attempt at least one question on this topic.

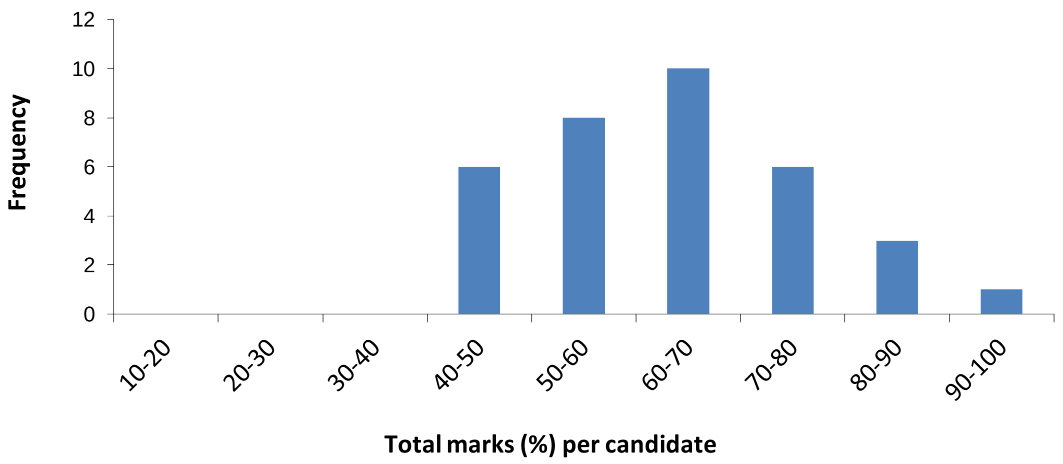
## MS3 – Transforming Materials

**Examiner(s):** Dr Paul Bagot
**Candidates:** 34
**Mean mark:** 63.15%
**Maximum mark:** 91%
**Minimum mark:** 41%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|---|
| 1 | 14 | 14.57 | 20 | 7 |
| 2 | 18 | 13.89 | 19 | 2 |
| 3 | 32 | 12.72 | 18 | 7 |
| 4 | 22 | 11.73 | 19 | 6 |
| 5 | 29 | 13.03 | 20 | 5 |
| 6 | 12 | 12.50 | 18 | 6 |
| 7 | 16 | 13.56 | 20 | 6 |
| 8 | 26 | 10.88 | 20 | 4 |

**Prelims 2012/13**
**Materials Science 3**



## Specific Comments

1. **Processing examples.** This question required an essay-type response to two different casting and two welding processes. It had the highest average mark, as there were a few options for obtaining credit in each part. Surprisingly it was not however a particularly popular question, perhaps due to time constraints for essay-type answers. Such questions however do make it clear which students have properly grasped key concepts.

2. **Thermodynamics fundamentals.** A moderately popular question that had the widest spread in marks obtained. A significant improvement in the 2011/2012 thermodynamics question, which allowed little scope for discriminating between students.

3. **Thermodynamics of Ellingham Diagrams.** The most popular question by far, with 94% of students attempting it. The structure of this question was good for offering some easier marks, but the latter stages required students to have a deep understanding of applying the course material. Most did well in sketching out the key lines for this question and showing they knew the implications of such diagrams.

4. **Kinetics of N2O5 decomposition.** This was answered reasonably well by all those who attempted it; the standard of answers was good with the average mark close to that of the similar question last year, despite additional sections being added to stretch students. Along with thermodynamics, this indicates students have a good grasp of these fundamental topics.

5. **Electrochemical cells.** The second most popular question which again had a broad spread of marks over all those who attempted it. Most marks were lost by silly errors such as incorrect signs or confusing some of the notation required in this module.

6. **Kevlar synthesis.** Another question where most of the available marks were for an essay-type response. This was the least popular of all questions followed by question 1, underlining students' aversion to this format of questions. Key concepts were confused in some responses which brought down the average mark, although the numerical part at the end was mostly answered well.

7. **Phase microstructures.** This question required a mix of written responses and sketches to course work, which was done reasonably well by those who attempted it (just under half of all students), reflected in the high average mark for it. The core concepts with this module had been well understood by most.

8. **Solutions, ordering and clustering.** This was the 3$^{rd}$ most popular question (76% attempting), but had by far the lowest average mark at only 10.9/20. A full score was obtained by some however showing it was within the reach of the students' understanding. The low mark may be due to its position as last question in the paper, as answers tended to be too brief to obtain full marks for each part. It might be best to suggest sketches for part a), as some answers that lacked these were too vague to assign credit.

## General Comments:

The average mark for this paper was down a significant level from last year (71%), which was as intended to bring it into line with other papers. This was achieved by further lengthening of certain questions, and ensuring the "easy marks" only made up a small proportion of the available total. These changes have not only reduced the average mark, but also given the top students better chances to demonstrate their competence; the peak mark was higher than the 2011/2012 paper. Compared to the other two papers (MS1 and MS2), this one had the lowest overall average mark, so further lengthening or increasing the difficulty of questions in future papers is unnecessary.

The average marks for each question were all quite similar, suggesting each individual question was fair and tested students effectively. Each also had a good attempt percentage, indicating no module or topic in particular was being actively avoided.

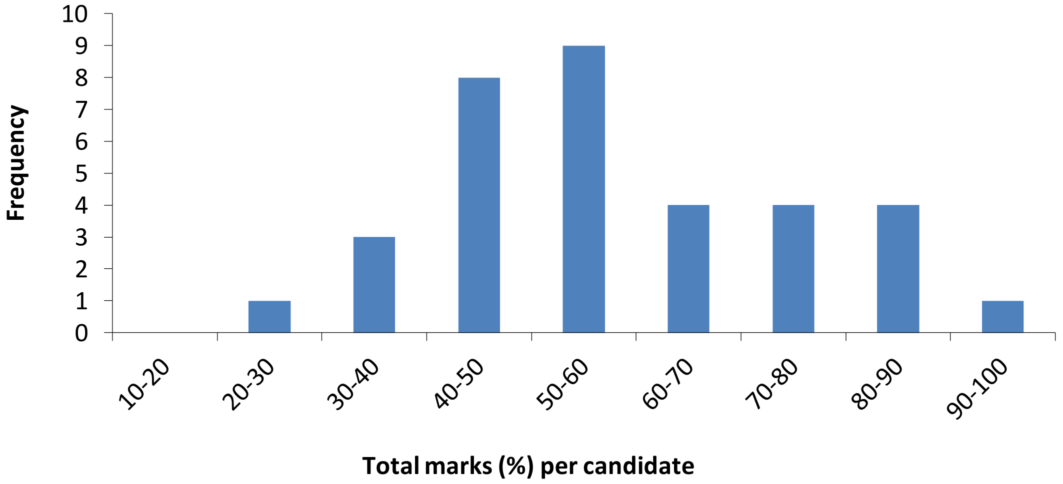
**Mathematics for Materials and Earth Sciences**

**Examiner(s):** **Dr Jonathan Yates**
**Candidates:** **34**
**Mean mark:** **59.14%**
**Maximum mark:** **92%**
**Minimum mark:** **26%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|---|
| 1 | 34 | 5.71 | 8 | 2 |
| 2 | 34 | 6.35 | 8 | 3 |
| 3 | 34 | 4.32 | 8 | 0 |
| 4 | 34 | 3.82 | 8 | 0 |
| 5 | 34 | 4.18 | 8 | 1 |
| 6 | 34 | 2.91 | 8 | 0 |
| 7 | 34 | 2.62 | 8 | 0 |
| 8 | 34 | 5.50 | 8 | 0 |
| 9 | 34 | 6.79 | 8 | 1 |
| 10 | 34 | 5.24 | 8 | 0 |
| 11 | 26 | 17.00 | 24 | 4 |
| 12 | 28 | 13.14 | 25 | 2 |
| 13 | 18 | 15.67 | 25 | 5 |
| 14 | 16 | 8.94 | 25 | 0 |
| 15 | 16 | 12.38 | 25 | 2 |
| 16 | 31 | 17.84 | 25 | 3 |

**Prelims 2012/13**
**MMES**



## General Comments

The exam followed the pattern of previous years: Section A contained 10 compulsory questions worth 8 marks each, Section B contained 6 longer questions worth 25 marks each from which 4 had to be attempted.

**Section A**
Q1: geometry of planes and normal vectors
Q2: reciprocal lattice vectors
Q3: eigenvalues and eigenvectors of 3x3 matrix
Q4: partial derivatives
Q5: Stationary points and curve sketching
Q6: indefinite integral
Q7: complex numbers
Q8: Taylor expansion
Q9: evaluation of limit
Q10: first-order differential equation
Quite a lot of candidates lost marks (and time) by trying to evaluate standard integrals and differentials, which were contained in the formula booklet. The lowest average mark was for the question on complex numbers. Many students did not make a serious attempt at this question. The highest marks were for the routine questions on reciprocal lattices, limits and 1$^{st}$ order ODEs.

**Section B**
*Q11 Vectors, planes and crystallography*
The first half of the question was bookwork. Students typically lost marks by assuming the crystal system was orthorhombic.
*Q12 Matrices, Eigenvectors*
A significant number of students failed to spot that one eigenvectors/value could be found by inspection, and others become confused as the matrix contained a variable (x).
*Q13 Partial Differentiation*
Most students could identify an exact differential, however marks were often lost by not clearly explaining why this was so.
*Q14 Integration*
Very low scores for this question, which is disappointing as it is quite standard. The first part is actually a tutorial question.
*Q15 Power series*
The key challenge in this question was deciding on the correct variable to expand in. A similar question appeared on the Trinity Term collection.
*Q16 Differential equation*
While the first part of this question was universally well done, many students did not understand the implications of the ‘bounded’ condition (despite it being expanded upon in the question).

The Earth Sciences examiner and I both felt that the paper was not significantly harder than previous MMES exams. There were a small number of very strong candidates, who between them produced near perfects answers to all questions. However, the average mark was somewhat lower this year than in previous years due to a significant number of low marks (<50%). Many candidates struggled with core concepts such as finding the eigenvectors of a 3x3 matrix. Hopefully, this is not the start of a trend – the material in the MMES paper underpins much of the FHS course. This should be monitored in future years.

The Earth Sciences examiner and I carefully compared our marking. We found no significant differences and are confident we have marked them consistently.

## Examination Conventions 2012/13
## Common Preliminary Examination
## Materials Science and Materials, Economics & Management

The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. These conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The examiners are nominated by the Nominating Committee* in the Department and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. In Prelims the examiners are called "moderators". Formally, moderators are independent both of the Department and of those who lecture. The paragraphs below give an indication of the conventions to which the moderators usually adhere, subject to the guidance of other bodies such as the Academic Committee in the Department, the Mathematical, Physical and Life Sciences Division, the EPSC and the Proctors who may offer advice or make recommendations to the moderators.
It must be stressed that to preserve the independence of the Moderators, candidates are not allowed to make contact directly about matters relating to the content or marking of papers. Any communication must be via the Senior Tutor of your college, who will, if he or she deems the matter of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Prelims.

(1) *Setting of papers*

The Moderators set the papers, but are advised to consult the course lecturers. The course lecturers are required to provide draft questions if so requested by the Moderators. The Prelims paper on Maths for Materials and Earth Sciences is set jointly by the Departments of Earth Sciences and Materials. There are no external examiners for Prelims.

(2) *Paper Format*

The Materials Science papers 1 - 3 comprise eight questions from which candidates must attempt five. Each question is worth 20 marks. The total marks available for each of these papers are 100. The Prelims paper on Maths for Materials and Earth Sciences consists of two sections, candidates are required to answer all questions in Part A and 4 from Part B.

(3) *Marking of papers*

For prelims double marking is not necessarily double "blind" marking. It is usually considered sufficient for the second marker merely to check the first marker's marks.

(4) *Marking of course practicals and crystallography classes*

First year practicals are assessed regularly by senior demonstrators in the teaching laboratory. The work done for crystallography classes is assessed by the Crystallography Class Organiser(s). The assessed work for both practicals and crystallography classes constitutes the Coursework Paper. Each of the five papers in Prelims, comprising the 3 Materials Science papers, Maths for Materials and Earth Sciences, and the Coursework Paper, carry equal total marks. Satisfactory performance in the practical work and in the crystallography classes is defined in the MS/MEM Prelims Handbook. Penalties for late submission of coursework are set out in this handbook.

* for the 2012-13 examinations the Nominating Committee comprised Prof Grovenor & Dr Taylor.

(5) *Classification*

The pass/fail border is at 40%.

The Moderators may award a distinction to recognise especially strong overall performance. Normally (i) at their discretion, the moderators may specify a mark in the range 70% to 79% such that candidates with an overall mark greater than or equal to this specified mark are awarded a distinction and (ii) a distinction will be awarded to all candidates with an overall mark of 80% or greater.

Failure in one or two written papers may be compensated by better performance in other written papers provided the candidate obtains at least 35% on the failed paper. Failure of three papers precludes compensation. Where compensation is permitted, only those marks in excess of 40 on a passed paper may be used towards compensation and normally this shall be at a rate of 3 marks to every deficit mark to be compensated.
For example, if two written papers are passed and marks of 36% and 38% are obtained in the remaining two written papers then the total for the four written papers must be at least 172 marks {36 + 38 + 2x40 + **3**×(4+2)} for both failures to be compensated

The Moderators have the authority to use their discretion and consider each case on its merit.

(6) *Failure of one or more Papers*

Failure of the coursework paper will normally constitute failure of the Preliminary Examination. Materials coursework cannot normally be retaken. Exceptionally a candidate who has failed the coursework may be permitted jointly by the Moderators and the candidate's college to retake the entire academic year.

Candidates who pass the coursework paper and fail 1 or 2 written papers will be asked to resit only those written papers.

Candidates who pass the coursework paper and fail more than 2 written papers will be asked to resit all 4 written papers.

The resits usually take place in September. To pass a resit paper the candidate must obtain at least 40%, and normally no compensation is allowed. There is only one opportunity to resit the examination, and failure to pass a resit examination normally results in the candidate being prevented from continuing to Part I. Exceptionally, a college may allow a student to go down for a year and take Prelims a second time the following June.

The Moderators have the authority to use their discretion and consider each case on its merit. In such cases they will take into account a candidate's profile across all elements of assessment together with, subject to guidance from the Proctors where appropriate, any other factors they deem to be relevant.

# REPORT ON FINAL HONOURS SCHOOL OF MATERIALS SCIENCE, PART I EXAMINATION

**Part I**

**A. STATISTICS**

(1) **Numbers and percentages in each category**

The Part I Examination in Materials Science is unclassified. No distinctions are awarded.

| Category | Number | | | Percentage | | |
|---|---|---|---|---|---|---|
| | 2012/13 | 2011/12 | 2010/11 | 2012/13 | 2011/12 | 2010/11 |
| Distinction | n/a | n/a | n/a | n/a | n/a | n/a |
| Pass | 21 | 28 | 21 | 100 | 97 | 100 |
| Fail | 0 | 1 | 0 | 0 | 3 | 0 |

(2) **If vivas are used**
As stated in the Examination Conventions, vivas are no longer used in the Part I examination.

(3) **Marking of scripts**
All scripts were double-blind marked by the Examiners and Assessors. The full procedures are described in the Examination Conventions.

**B. NEW EXAMINING METHODS AND PROCEDURES**

None this year.

**C. CHANGES IN EXAMINING METHODS, PROCEDURES AND CONVENTIONS WHICH THE EXAMINERS WOULD WISH THE FACULTY AND THE DIVISIONAL BOARD TO CONSIDER**

None this year.

**D. EXAMINATION CONVENTIONS**

The previous year's Examination Conventions were included in the Course Handbook that was distributed to all candidates in hard-copy and was also made available on the Departmental website, to which candidates' attention was drawn by e-mail. The current year's Conventions were put on the Departmental website and sent electronically, along with other information in a letter from the Chair of Examiners to all candidates, on 15 March 2013, and in hard copy for the start of Trinity term. The Examination Conventions were agreed by the Board of Examiners and the Department's Academic Committee.

**Part II**

**A. GENERAL COMMENTS ON THE EXAMINATION**

There were 21 candidates for the examination, and all were awarded Honours. The examination consisted of 6 written papers plus coursework that included a team design project, a business plan, industrial visit reports and practical work carried out during the 2$^{nd}$ year. Three candidates opted to take supplementary subjects; eight candidates opted to take the Foreign Language Option. These replaced the business plan. In addition, candidates completed further coursework in the 3$^{rd}$ year in the form of either a module on Materials Characterisation (5 candidates) or one on Materials Modelling (15 candidates). One candidate who withdrew from the Part I Examination last year returned to sit only the written papers, and was not required to redo the coursework components of the examination.

Each written paper lasted 3 hours. For the General papers, candidates were required to answer 5 questions out of 8, as in previous years. For Options Paper 1, candidates were offered 10 questions in 5 sections each containing 2 questions; candidates were required to answer 4 questions, 1 from each of three sections and 1 from any of the same three sections. For Options Paper 2, candidates were offered 12 questions in 6 sections each containing 2 questions; candidates were required to answer 4 questions, 1 from each of three sections and 1 from any of the same three sections.

Team design projects were marked by two Examiners, one of whom was the Chairman. Teams were marked as groups. The allocation of bonus or penalty marks is permitted under the Conventions, but this was not applied by the examiners this year.

The business plans, submitted in the second year, were marked by an Assessor from Isis Innovation and an Assessor appointed to represent the Faculty of Materials, again with teams being marked as a group. See further comment in Section E.

Candidates' work on the two coursework modules was marked either by 2 Assessors (modelling) or 2 of 3 Assessors (characterisation). The Chair of Examiners further examined a number of representative scripts from both modules, but felt that no further moderation of marks was necessary.

Reports for each of the Industrial Visits were assessed as pass/fail by the Industrial Visits Organiser, appointed as an Assessor.

The overall mean mark for Part I was at the lower end of the 2(i) band. All MS and MEM general papers and option papers results were considered. Despite a rather low overall mean mark, the distribution of marks was distinctly bimodal, with some high marks. After extensive discussion of the examiners, it was agreed that the papers were fair, and the mark was being pulled down by weak performances by some candidates. Of particular concern were apparent weaknesses in the areas of mechanical properties of materials and metallurgy.

**B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER**

The performance of the male and female candidates was as follows:
Written Papers Averages – M 62.36, F 55.00% (Overall 60.94%)
Coursework Averages – M 70.31%, F 69.71% (Overall 70.04%)
Overall Part I Averages – M 64.35%, F 58.68% (Overall 62.43%)

Insofar as can be judged from the small sample size, the performance of male and female candidates was not statistically significantly different. This statement is based on the standard deviation of the written paper averages, which was ±14.67% points for the male candidates and ±9.15% points for the female candidates. Both male and female groups of candidates performed better in the coursework than in written examinations.

Where approved by the Proctors, candidates were allowed (i) extra time on account of dyslexia / dyspraxia, and/or (ii) other special arrangements. These allowances seemed satisfactory.

| | Overall mark | | Written Examinations | | Coursework | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 30-40 | | - | 2 | - | | - |
| 40–50 | 2 | - | 1 | 2 | - | - |
| 50–60 | 4 | 4 | 4 | 3 | 1 | - |
| 60–70 | 3 | 1 | 2 | - | 4 | 3 |
| 70–80 | 5 | 1 | 5 | 1 | 10 | 3 |
| 80–90 | 1 | - | 1 | - | - | - |
| Totals | 15 | 6 | 15 | 6 | 15 | 6 |

## C. DETAILED NUMBERS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

All candidates took the same papers for the whole examination, in that there were no optional written papers.

## D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

Detailed comments on the written examination papers and overall candidates' performance on individual questions are attached.

## E. COMMENTS ON THE PERFORMANCE OF IDENTIFIABLE INDIVIDUALS AND OTHER MATERIALS WHICH WOULD USUALLY BE TREATED AS RESERVED BUSINESS

One medical certificate was received and considered for illness [redacted]

| | | | | |
|---|---|---|---|---|
| [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

[redacted] late business plan [redacted]

## F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

| | |
|---|---|
| Prof. P.D. Nellist (Chairman) | Dr H.E. Assender |
| Prof. S.G. Roberts | Prof. T.J. Marrow |
| Dr K.A.Q. O'Reilly | Dr A.A.R. Watt |
| Prof. M.G. Burke (external) | Prof. W.M. Rainforth (external) |

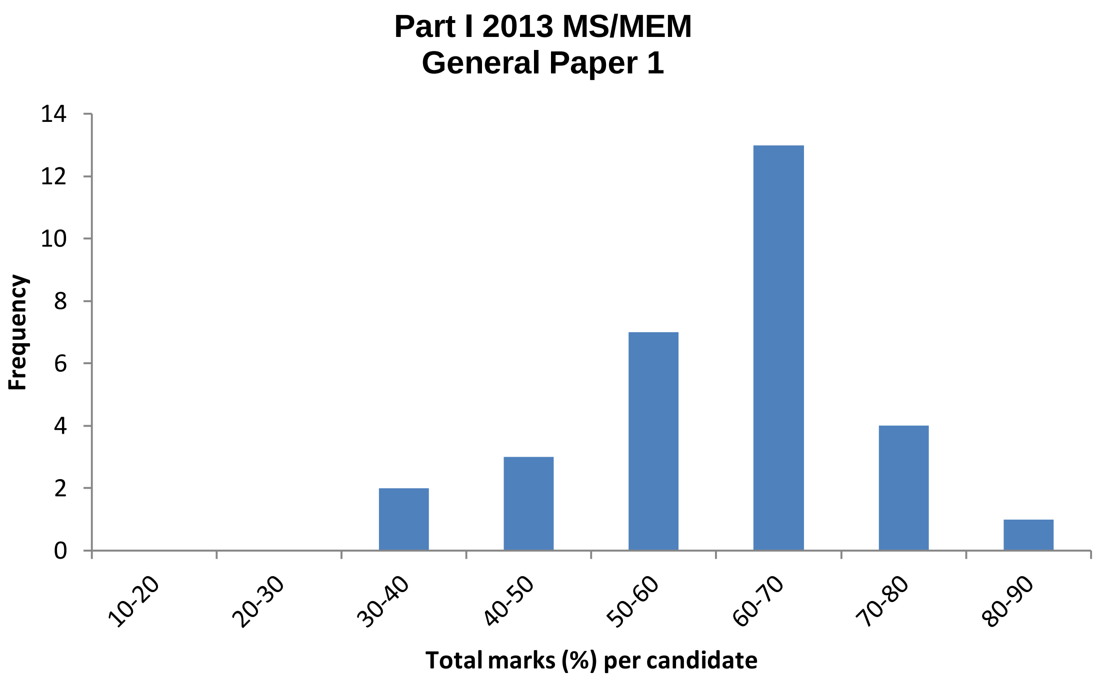
**Attachments:** Examination Conventions 2012/13 Final Honours School Materials Science
Comments on General Paper 1
Comments on General Paper 2
Comments on General Paper 3
Comments on General Paper 4
Comments on Materials Options Paper 1
Comments on Materials Options Paper 2

## General Paper 1 – Structure and Transformations

**Examiner:** Prof. James Marrow
**Candidates:** 30 (21 MS / 9 MEM)
**Mean mark:** 61.57%
**Maximum mark:** 84%
**Minimum mark:** 37%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 28 | 12.21 | 17 | 7 | Phase Transformations |
| 2 | 16 | 12.44 | 16 | 4 | Phase Transformations |
| 3 | 20 | 13.35 | 18 | 5 | Ternary Phase Diagrams |
| 4 | 26 | 13.58 | 19 | 5 | Diffusion |
| 5 | 17 | 12.06 | 18 | 6 | Surfaces and Interfaces |
| 6 | 21 | 11.19 | 18 | 7 | Corrosion |
| 7 | 9 | 9.67 | 13 | 4 | Powder Processing |
| 8 | 13 | 11.69 | 15 | 6 | Microstructure of Polymers |



## General Comments:

Question 1

a) Generally aware of effects of temperature on driving force and kinetics, and many introduced the Gibbs-Thomson effect. Majority did not use the concept of growth rate dependence on radius to explain how this gave similar size dendrites, not how dendrites could shrink.

b) Most derived the equation and stated assumptions (with some ambiguous solutions), but many did not define variables or give explanation of difference from equilibrium in much depth.

c) Common error was not to give any relation that could be used to estimate time for homogenisation, but generally well done.

Question 2

a) Generally well answered, though generally not noting effects of nucleation site density on phase growth rate by lateral growth, nor constant rate controlled by thermodynamic driving force for continuous growth rate.

b) Qualitatively answered by most, majority missed explanation of how the position dependent energy was overcome by undercooling.

c) (i) Most did not explain why spiral pitch depends on delta T due to Gibbs-Thompson effect, (ii) Generally good, but explanations of the high nucleation energy of step not clearly given, (iii) generally well answered by those who identified solute drag.

Question 3

a) Some students did not explain clearly the role of equilibrium tie-lines (or mention them at all), and most seemed unaware of how phase boundaries are obtained experimentally, i.e. from cooling experiments.

b) (i) and (ii) done well by all, (iii) quite variable. Most did not give any information on how they had arrived at their diagram.

Question 4

a) Generally well done by those who recalled the basic concepts of substitutional diffusion, though many neglected entropy from the start of the derivation.

b) Most understood the difference between the polymer diffusion mechanisms, but answers were lacking in detail.

c) Generally well answered

d) Generally good, though some did not explain why higher order terms decayed more rapidly, and lacking mathematical descriptions.

Question 5

a) Some did not explain the mechanisms of surface creation in liquids and solids.

b) Generally lacking in detail, particularly the ratio of the surface unit cell to the bulk termination cell, with lack of detail in the quoted examples.

c) Few explained the relative differences of the planes, most understood how to construct the equilibrium shape.

d) Concept of construction to obtain the energy ratio understood by most, but many errors in basic trigonometry.

Question 6

a) Most identified cathodic protection, but answers lacked detail. Many did not consider paint as an additional requirement for areas above the water line.

b) Most identified the passive film and anodisation as suitable processed. Level of detail to explain this varied.

c) Inhibition by passivation identified by most, reasonably detailed answers though some lacked focus on optimum solution for this system and how it may fail.

d) Not well answered by most, with lack of consideration for the actual environmental effects (wet/dry cycles) and practicality of protecting this component.

Question 7

a) Generally good quality “textbook” answers, but some discussed stages of sintering rather than mechanisms.

b) Few mentioned the physics that leads to sintering diagrams, nor described how they may vary, with powder size for example.

c) Answers not well organised – few noted that pre-alloyed powder is less-soft and ductile than elemental powders, nor identified the consequences of this.

d) None provided the required answer – “liquid phase sintering”

Question 8

a) Level of detail in answers could be greater, including size of spherulites and methods for controlling size other than cooling rate.

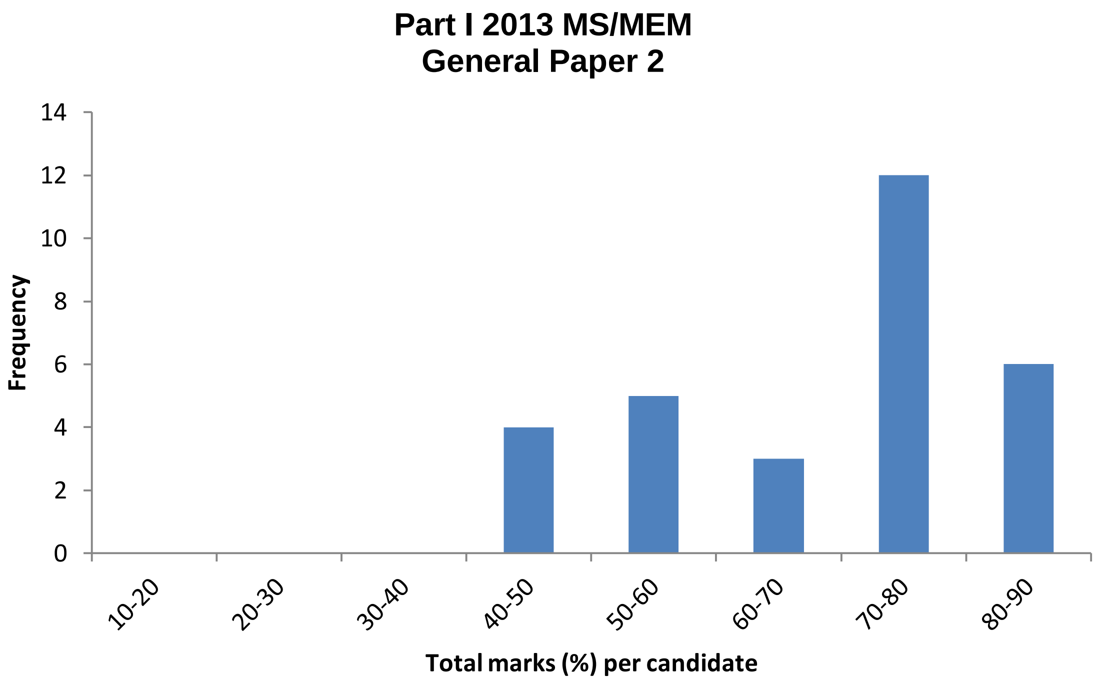
b) Most were not able to relate the calculated periodicity to specific features of the structure of a semi-crystalline polymer. Confusion about the difference between wide angle and small angle experiments.

## General Paper 2 – Electronic Properties of Materials

**Examiner:** Prof. Peter Nellist
**Candidates:** 30 (21 MS / 9 MEM)
**Mean mark:** 69.90%
**Maximum mark:** 90%
**Minimum mark:** 42%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 26 | 14.73 | 19.5 | 3.5 | Electronic structure |
| 2 | 17 | 16.18 | 19 | 13 | Electronic structure |
| 3 | 26 | 15.87 | 20 | 10 | Tensor properties |
| 4 | 9 | 9.67 | 13 | 4 | Quantum mechanics |
| 5 | 29 | 13.64 | 19.5 | 3 | Statistical mechanics |
| 6 | 20 | 12.85 | 17 | 7 | Magnetic properties |
| 7 | 8 | 6.88 | 11 | 2.5 | Semiconductors |
| 8 | 15 | 14.37 | 18.5 | 8 | Electrical properties |



## General Comments:

The average mark for this paper was encouragingly high, though the distribution of marks was distinctly bimodal. Candidates who were confident with the more mathematical and numerical questions scored highly, through being able to select the relatively straightforward questions, with weaker candidates suffering. Overall, however, the scripts displayed a high degree of ability and understanding in the topics covered by this paper.

Question 1 on electronic structure was very popular with a high average mark. Although it was a relatively straightforward question, it did require a good knowledge of the key quantities associated with the free-electron model. A common problem was the lack of, or incorrect, units, for example when quoting a density of states.

Question 2 on tight-binding theory in electronic structure was a little less popular, but with a high average mark, perhaps resulting from a degree of self-selection. For what has been historically an unpopular topic, it was answered confidently by many. Typical errors included not identifying the Brillouin zone and not giving numerical values when asked.

Question 3 on tensor properties was a popular and high average mark question. It was a reasonably standard Mohr’s circle question, but did require some thought regarding why the result was independent of strip width. It was in converting field to potential that most errors occurred.

Question 4 quantum mechanics was a more discursive question with only a small component of numerical work. It was quite an unpopular question, with a low average mark. Typical errors included not mentioning diffraction in part (a)(i) not mentioning a single valued wavefunction in (a)(ii) and using a formula appropriate only for photons in part (b).

Question 5 was a question on the statistical mechanics associated with magnetic polarisation of a material, which should be well familiar to candidates. It was a very popular question with a large spread of marks showing good discrimination. Many errors were simply leaving out parts that were asked for, such as the examples in (a)(i and ii) and the actually value of the probability in part (b)(ii).

Question 6 was quite a popular question, with a good average mark. Part (b) was generally answered well, with the more discursive part of (a) causing some problems and a distinct lack of knowledge about how to handle the quantities given in part (c).

Question 7 was an unpopular and poorly scoring question on carrier densities in semiconductors. Although it was in an area that should be familiar to students, I suspect that it was answered by weaker students, with part (b) in particular causing difficulties.

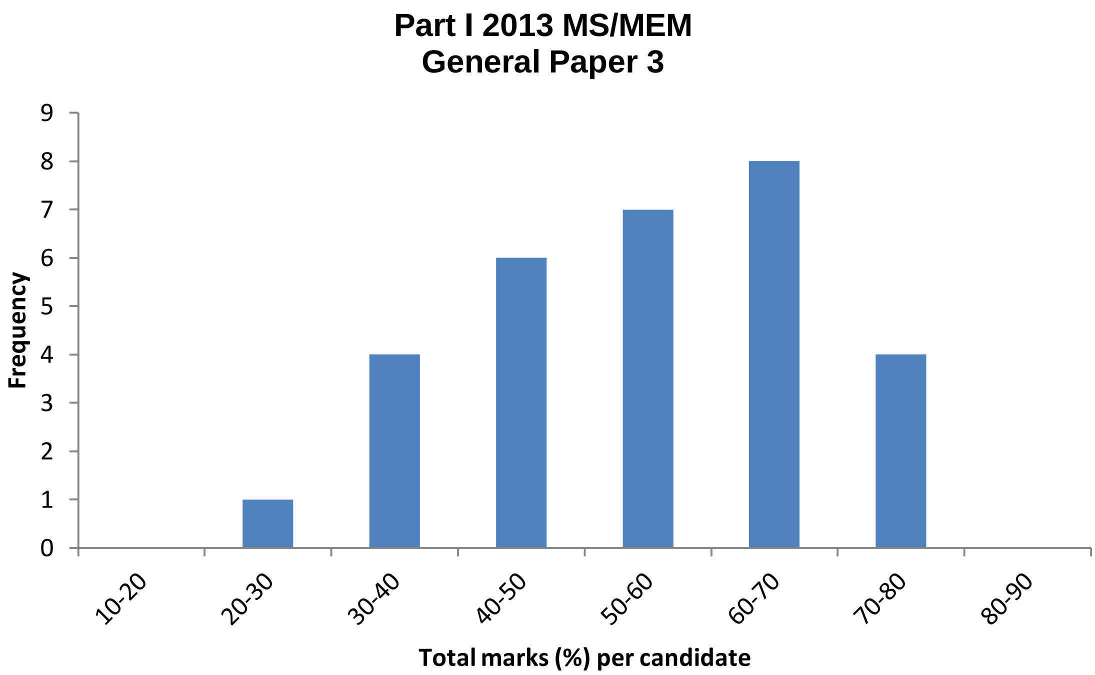
Question 8 was a more discursive question on superconductors. Most answers showed a good knowledge in this area.

## General Paper 3 – Mechanical Properties

**Examiner:** Prof. Steve Roberts
**Candidates:** 30 (21 MS / 9 MEM)
**Mean mark:** 55.73%
**Maximum mark:** 79%
**Minimum mark:** 26%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 28 | 11.57 | 19 | 3 | Elasticity |
| 2 | 20 | 11.05 | 18 | 2 | Polymers; elastomer mechanics |
| 3 | 25 | 8.36 | 12 | 3 | Microplasticity; hardening mechanisms |
| 4 | 7 | 12.00 | 16 | 4 | Microplasticity; dislocation mechanics |
| 5 | 16 | 8.31 | 17 | 1 | Macroplasticity |
| 6 | 24 | 13.00 | 18 | 6 | Fracture |
| 7 | 19 | 12.58 | 17 | 5 | Composites; toughness |
| 8 | 11 | 12.73 | 18 | 6 | Creep |



## General Comments

A very wide spread of marks, with the average mark for the paper and for each question brought down by some very poor answers. In quite a few cases, the poor answers were not ones where the candidate had written very little, but where an answer completely missed the point of the question or was just wrong. The internal and external examiners carefully re-examined the paper, and concluded that the paper as a whole, and each question on it, was fair and at an appropriate level. This view was reinforced by the significant number of good or very good answers to each question.

1) Elasticity: A "standard" question, with over half the marks to be gained by easy prelims level stuff, and a core "book work". The problem was straightforward: only the last three marks needed real thought, realising that shear stress is the critical parameter. Even so, there were only a few good answers. Failures were various: inability to do simple calculus or algebra, inability to see (easy) boundary conditions, radius/diameter confusion… A few candidates misunderstood pretty well everything.

2) Polymers; elastomer mechanics: Popular, but on the whole not well done. Many did not do what (b) asked, but wrote generally, and often inaccurately, about elastomers; (c) was often well done in terms of algebra, but without explanation. In (d), the contribution of bond-stretching was generally missing, though many described alignment of polymer chains. There were some wildly wrong answers, showing next to no knowledge of the topic.

3) Microplasticity; hardening mechanisms: Considering the concepts being explored here were very basic, the general level of understanding was very poor. Most of this was first-year material, expanded in the second year course. Common errors included: not converting lattice parameter to atomic radius (all but one student), electrical charge interactions between solutes and dislocations in metals, dislocations bowing around solute atoms (or cutting them…).

4) Microplasticity; dislocation mechanics: Unpopular: divided those who did it into those who basically knew their stuff (the majority), and those who didn't at all. In (b), few supported their answers with estimates of the order of magnitude changes in dislocation density with strain, and explanations were limited in detail. In (c), surprisingly all but one candidate went for the Lomer-Cottrell lock in FCC, which is the most difficult possibility. No one could get the crystallography to work out, and no-one gave any explanation of the energetics of lock formation.

5) Macroplasticity: As expected, this question distinguished between those who genuinely understood the principles behind "proofs" gone through in lectures, and those who didn't, but could rote-learn them. Credit was given for plausible (if not really germane) explanations, but even so average marks were very low.

6) Fracture : A relatively easy question, as part (b) and (c) were very straightforward: only a few lost marks there, often by confusing units. In part (a), the arguments were very often not made clearly, with lots of talking around the topics without getting to a conclusion: none gave a clear explanation (such as a diagram) of how changes to toughness and yield stress would affect the DBTT, and in the worst cases answers were simply wrong.

7) Composites; toughness: Parts (a) and (b), which included some explanation, were variably well done: students were more comfortable on part (c), which was just rote-work. Marks were deducted for not explaining "derivations".

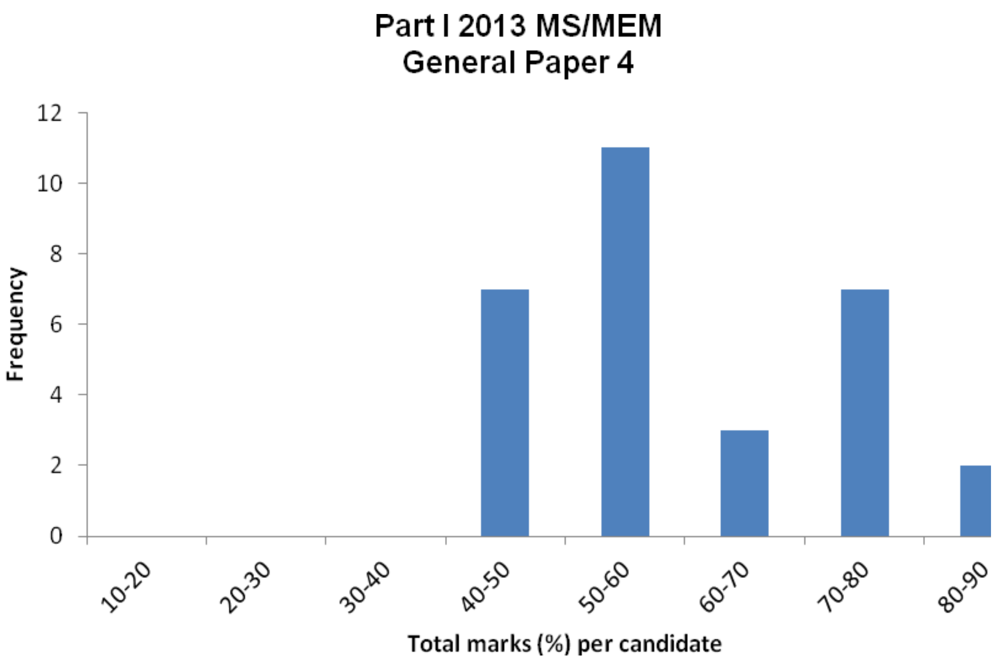
8) Creep: "Proofs" in part (b) were done mostly well, marks were deducted for not explaining the process. Part (a) was done variably well; this and (c) differentiated between those who really knew their stuff and those who didn't.

## General Paper 4 – Engineering Applications of Materials

**Examiner:** Dr Hazel Assender
**Candidates:** 30 (21 MS / 9 MEM)
**Mean mark:** 61.23%
**Maximum mark:** 86%
**Minimum mark:** 43%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 26 | 11.77 | 17 | 3 | Microstructural Characterisation |
| 2 | 27 | 12.93 | 18 | 7 | Microstructural Characterisation |
| 3 | 9 | 12.22 | 17 | 9 | Polymers |
| 4 | 2 | 9.50 | 12 | 7 | Ceramics and glasses |
| 5 | 24 | 12.17 | 17 | 7 | Ceramics and glasses |
| 6 | 23 | 13.04 | 18 | 6 | Semiconductor Devices |
| 7 | 16 | 9.44 | 16 | 2 | Engineering Alloys |
| 8 | 22 | 14.09 | 19 | 9 | Engineering Alloys |



## General Comments

A cluster of strong, and a second cluster of weak marks, with a reasonable average mark.

**Question 1:** *TEM imaging.*
A popular question with a modest mean mark. (a) Generally good responses on the bookwork on aberration sources, albeit with some loose descriptions, but the second part on astigmatism was poorly answered (most did not consider how it could be corrected). (b) Many candidates did not get all the steps in this calculation e.g. remembering the bcc criterion, and several used the expression for spherical aberration. In many cases the candidates did not appear to have a clear understanding of the geometry/problem. A significant number of candidates did not attempt the second part of the question on ultimate resolution. (c) Many non-attempts to this section. Several used numerical aperture instead of Bragg angle despite this question being related to lattice imaging rather than diffraction contrast.

**Question 2:** *SEM*.
The most popular question, attempted by all but three candidates, with a reasonably good mean mark. (a) Generally well answered, with occasional confusion between SE and BSE. Where marks were lost, it was usually in not knowing the electron energies. (b) Lots of good answers. (c) The weakest section of the question: most candidates had the basic idea of magnification in the SEM, but were considerably weaker on TEM. Several candidates confused resolution with magnification and few correctly identified the adjustment needed for TEM high magnification.

**Question 3:** *Conjugated polymers and NLO's*.
As anticipated for a question on a topic not appearing in exams previously, this was not a popular question, but the mean mark was around the average for the paper. (a) There was often difficulty describing the bond arrangement leading to delocalisation. (b) A significant proportion of candidates did not address the first sentence of the question and no-one explained why (without bond length resonances included) the delocalised electrons would be expected to lead to metallic behaviour. Conduction mechanisms were well-described. (c) Few candidates could address this section of the question. Credit was lost in being unable to link the equation back to frequency doubling in _some_ component of the light. (d) Advantages and disadvantages of polymers as NLO's were generally well described, but a significant proportion of candidates could not link high polarizability with conjugated chains.

**Question 4:** *Cement*.
A very unpopular question. (a) Reactions were OK, but candidates needed to consider the differences between the various starting components. (b) Poor microstructural descriptions. (c) Poor origins of porosity, but good on removal routes. (d) mixed response.

**Question 5:** *Sintering and Weibull modulus.*
Popular question. (a) Generally good answers. The best marks were awarded to candidates who could describe where the fundamental difficulties with residual porosity were discussed in terms of diffusive processes during sintering. (b) Generally well answered, although some examples were given that would have a relatively minor impact on porosity. (c) Some candidates appeared to forget the first part of this section (defining the terms). Many struggled with the Weibull calculation, although most could outline the methodology. Most difficulty was had in determining the probability of survival. (d) Very poorly answered section, requiring thinking about the experiment, with few marks awarded.

**Question 6:** *Solar cell pn junctions*.
Popular question with a high mean mark. (a) Generally well answered. Most candidates could draw the band diagram of the pn junction and give a good discussion of the general diode behaviour, but marks were lost in the careful consideration of the balance of drift and diffusion currents. (b) Generally well answered. Most candidates could explain about the maximum power operation point well. Often the consideration of the short and open circuit conditions was limited to statements that there is no voltage and current respectively. (c) A challenging part of the question. Many candidates could identify basic cell design issues such as having an appropriate band gap, but were less able to identify materials issues that limit efficiency in existing solar cell technology (e.g. recombination). (d) A spread of scores in this section. Nearly all candidates mentioned that the different semiconductors can absorb light at different wavelengths for some credit, but many then did not describe how they were combined to lead to higher efficiency.

**Question 7:** *Ti-Al-V and beta Ti alloys.*
Not a very popular question, with the weakest mean mark. (a) Answers were often disappointingly confused about the desirable microstructures for the different properties. Most candidates could explain the α-β structure and phase behaviour. A frequent weakness was the description of the process history. (b) The main weakness was again describing the processing of these alloys. Some candidates did not consider the possibility of α-phase formation. Answers were stronger on properties and applications.

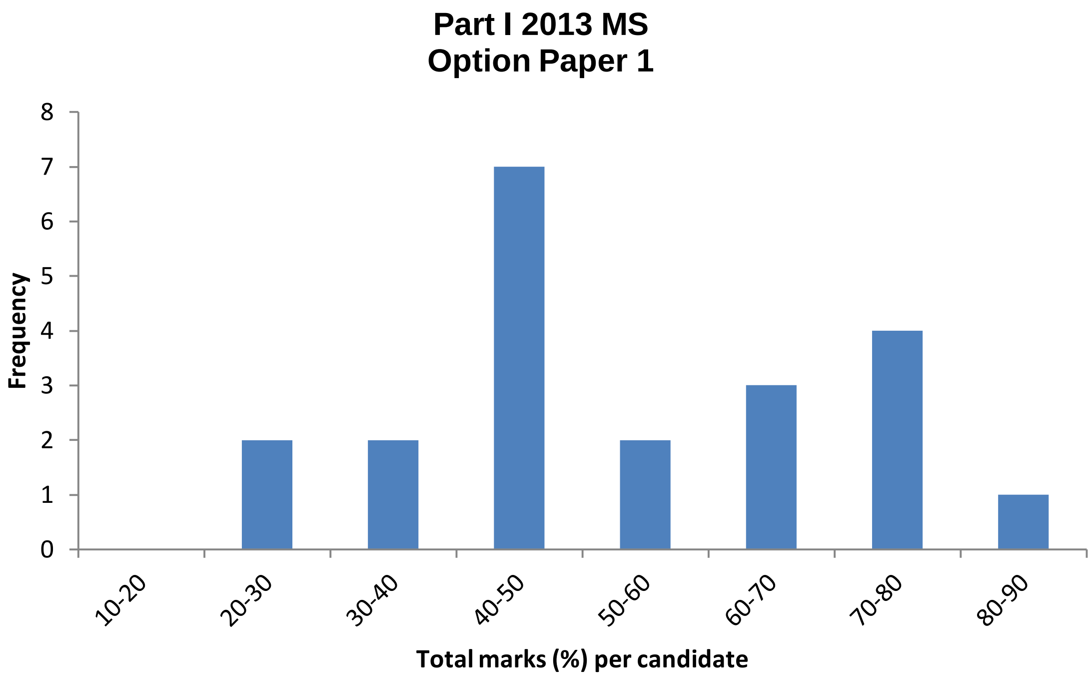
**Question 8:** *Eutectoid and hypoeutectoid steels.*
A reasonably popular question attracting the highest mean mark. (a) Generally very well answered. A few candidates did not describe a return to the austenitic phase for part (ii). (b) The most challenging section of this question. A significant number of candidates did not discuss bainite at all, and several lost marks for not describing microstructure (just listing phases/crystallography) or mechanical properties. (c) Generally well answered.

## Materials Options Paper 1

**Examiner:** **Dr Andrew Watt**
**Candidates:** **21 (MS)**
**Mean mark:** **55.14%**
**Maximum mark:** **89%**
**Minimum mark:** **29%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 10 | 11.60 | 18 | 7.5 | Strength and Failure of Materials |
| 2 | 11 | 12.41 | 19 | 6 | Strength and Failure of Materials |
| 3 | 1 | 19.00 | 19 | 19 | Nanomaterials |
| 4 | 5 | 16.80 | 24 | 7 | Nanomaterials |
| 5 | 6 | 17.08 | 24.5 | 6 | Prediction of Materials Properties |
| 6 | 4 | 19.00 | 21.5 | 15.5 | Prediction of Materials Properties |
| 7 | 7 | 12.86 | 22 | 6 | Materials & Devices for Optics & Optoelectronics |
| 8 | 15 | 14.60 | 19 | 4 | Materials & Devices for Optics & Optoelectronics |
| 9 | 11 | 11.27 | 20 | 5 | Engineering Ceramics: Synthesis & Properties |
| 10 | 14 | 13.21 | 20 | 4 | Engineering Ceramics: Synthesis & Properties |



**General Comments**

Overview: The mean mark of the paper was 55.14%, considerably lower than last year's 62.24%. The distribution of marks was rather bimodal with candidates scoring mostly in the 40-50% or 70-80% ranges. There was a good spread of results indicating that the exam could distinguish between the candidates' abilities. However the low average mark suggests that either the level of difficulty was too high for an average student or that the students did not revise a broad enough curriculum and this year the more popular subject's questions were harder than previous. Overall the more mathematical questions are the least popular. Four candidates consistently struggled through the paper and brought down the mean mark.

1. A reasonably popular question on structural engineering alloys and crack formation. Majority of answers were average and few candidates excelled.

2. Another question on alloys, again popular, focused on microstructure and processing. Similarly to question 1, with a couple of notable exceptions the majority of candidates failed to excel.

3. Only 1 candidate answered this question this year compared to 8 in 2012, 0 in 2011 and 1 in 2010. That candidate, however, responded with a very good answer. The question's subject was very similar to last year but more mathematically inivolved. Candidates were required to evaluate ballistic conductance and melting temperature of nanowires and nanoparticles respectively.

4. Unlike last year this was very unpopular with only 4 responses. The question was relatively easy and considered quantum confinement in nanoparticles, the question consisted mainly of bookwork and a small calculation worth 7 marks. The average mark was around the good 2.i mark suggesting the question was at an appropriate level.

5. A question considering phonons in superconductors. 6 candidates responded - an improvement on last year's 2, the average mark was on the 2.1/1 border suggesting the question was a little easy.

6. A question on the dielectric function of materials. Again an improvement in number of answers on last year, all candidates that responded answered well with an average mark of 19/25. In line with previous years this question along with 3 and 5 discourage students due to the strong mathematical requirements.

7. A question on optoelectronic devices, only 7 students answered this question and most struggled with a couple of notable exceptions.

8. The most popular question in the paper with 15 response the average mark being around the 2.i/2.ii interface. On the down side the question required mostly book work and did not have any mathematical component to test candidates.

9. The less popular question on ceramics on fracture toughness, 11 answers with a wide range of marks around the 2.ii/3 mark.

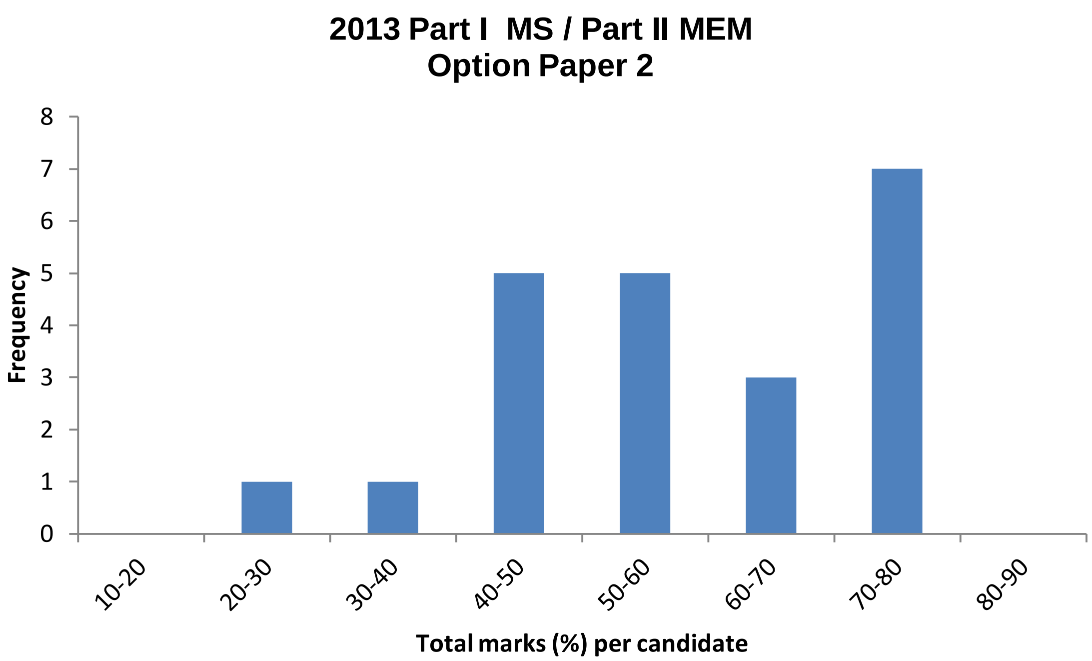
10. Second most popular question in the paper on sintering and mechanical properties. There was a mistake in part (a) "soft" should have been "hard", this obviously threw candidates and the examiners marked accordingly. Average of a high 2.2 a poorer performance than last year's similar question.

## Materials Options Paper 2

**Examiner:** Dr Keyna O'Reilly
**Candidates:** 22 (21 MS / 1 MEM)
**Mean mark:** 59.27%
**Maximum mark:** 80%
**Minimum mark:** 29%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 8 | 14.00 | 17 | 10 | Polymer interfacial fracture energy |
| 2 | 7 | 17.57 | 21 | 13 | Polymer analysis techniques |
| 3 | 3 | 15.00 | 16 | 13 | Steels and cast irons |
| 4 | 4 | 15.00 | 20 | 8 | Al alloys – additions & joining |
| 5 | 3 | 9.33 | 10 | 9 | Energy generation – nuclear & wind |
| 6 | 10 | 13.70 | 18 | 9 | Energy from coal, and batteries |
| 7 | 6 | 11.67 | 18 | 5 | Mg and Ti alloys |
| 8 | 2 | 8.50 | 14 | 3 | Ferritic alloys, and Sc in Al |
| 9 | 17 | 17.12 | 25 | 11 | Materials used in the body |
| 10 | 13 | 14.92 | 22 | 6 | Hip replacements |
| 11 | 9 | 14.67 | 21 | 5 | Doping of ceramics |
| 12 | 6 | 15.83 | 22 | 4 | Czochralski & gallium arsenide |



## General Comments

A very wide spread in performance for this paper with marks for individual questions ranging from three to 25 (out of 25). A significant number of candidates did very well overall, but the majority performed, on average, less well than expected. Particularly worrying is the very poor understanding of anything to do with metallic materials by some candidates.

## Specific Comments

### ADVANCED POLYMERS

Question 1. Polymer interfacial fracture energy.

Not a particularly popular question on the work of adhesion between two polymers and the determination of the interfacial fracture energy. In part a), not all candidates got the correct equation and several assumed the case where the two materials were the same. Part b) was generally well answered. A significant majority of candidates were not able to do the calculation in part c)i). Some tried to use the $G_{Ic}$ data as part of the calculation, rather than to show the trend. c)ii) was generally well answered, particularly with regard to what the possible mechanisms are.

Question 2. Polymers analysis techniques.

Again, not a particularly popular question, but generally well answered. This question covered the analysis techniques of dynamic mechanical thermal analysis (DMTA), neutron scattering and quasi-elastic neutron scattering (QENS). The section on DMTA was very straightforward and well answered. In the section covering neutron scattering, most candidates managed to answer three out of the four sub-sections reasonably well, with no particular sub-section badly answered. In the section covering QENS, most candidates struggled with one or two of the four sub-sections, but again there wasn't a particular sub-section which proved particularly difficult.

### ADVANCED MANUFACTURE WITH METALS AND ALLOYS

Question 3. Steels and cast irons.

A very unpopular question. The first part of the question covered the castability of mild steel. Answers generally lacked detail and an appreciation of the effects of shrinkage. The second part of the question covered grey cast irons and the processing required to develop similar properties to those of continuously cast steels. Most answers to this section were of a good standard, and described the mechanisms involved in good detail. The final part of the question dealt with welding techniques for joining thick steel sections. Submerged arc was generally well described, while many candidates did not know what electroslag welding is. Thermit welding was reasonably described, but several candidates did not give sufficient detail in their answers.

Question 4. Al alloys – additions and joining.

Another unpopular question with a wide spread of marks. The question covered additions made to Al alloys shortly before casting and joining methods for Al alloys. Answers to the grain refiner (Al-Ti-B) part of the question lacked detail as to the reasons for making the additions i.e. not just to refine the grains. The modifier addition (Na) was generally answered better, with reasonably good detail as to the mechanisms involved. Answers to the joining part of the question were generally well answered except some candidates were not aware that Al has a tenacious oxide film which makes it difficult to join.

### MATERIALS FOR ENERGY PRODUCTION< DISTRIBUTION AND STORAGE

Question 5. Energy generation – nuclear and wind.

A very unpopular question which was not well answered. The question concerned energy generation by nuclear and by wind. The first part of the question was about load factors for these two types of generation. Load factor was generally incorrectly defined and understood in answers, though it was covered explicitly in lectures and defined in the question! The terms in part b) were generally incorrectly defined in answers and lacked discussion of how reactivity (response with temperature) varies. Part c) was not well answered, as it needed an understanding of reactivity coefficient from part b). Satisfactory answers were given for the need for materials innovation for off-shore wind turbines, but they lacked detail and justification of materials innovation.

Question 6. Energy from coal, and batteries.

A reasonably popular question, though with a wide range of marks. The question covered energy generation in a coal combustion plant and energy storage in various types of batteries. The part of the question asking for a description of a coal combustion plant and the key materials challenges was generally well answered. However, several candidates didn't know what a Rankine cycle is, and this part of the question was generally poorly answered. Knowledge of the principle of operation of a battery and descriptions of the Daniell cell were generally answered well, though some candidates got the reactions round the wrong way and others didn't have separate electrolytes. Knowledge of lithium ion batteries was virtually non-existent.

**ADVANCED ENGINEERING ALLOYS AND COMPOSITES**

Question 7. Mg and Ti alloys.

Not a very popular question on the applications of Mg and Ti alloys, which had some good answers and some very poor answers. The first part of the question on comparing the properties of pure Mg and Ti was generally well done. The second part of the question on suggesting Ti alloys suitable for particular applications and the alloys conventionally used, produced more mixed answers. A lot of candidates incorrectly thought that Cu alloys are used for pipes for chemical processing. There were some good answers for the landing gear for large passenger aircraft, as was also the case for jet turbine blades, though here several candidates incorrectly selected Ti64 as an appropriate alloy.

Question 8.  Ferritic alloys, and Sc in Al.

A very unpopular question which was not at all well answered. The suspicion is that some candidates who answered this question had not attended the lecture course and were attempting to answer the question with their knowledge of Engineering Alloys from the General Papers. Unfortunately for them the particular ferritic alloys used in the question were not covered in the General Paper course. The section on the advantages and disadvantages of adding Sc to Al alloys was uniformly very poorly answered.

**BIOMATERIALS AND NATURAL MATERIALS**

Question 9. Materials used in the body.

The most popular question on the paper with a high average mark. The section on tissue expanders was generally well answered although many candidates lost marks for limited discussion of the materials used and the reasoning for this. Many candidates could not remember which polymers are used for replacement blood vessels and marks were also lost for poor discussion of their porous structure. Most candidates could identify the materials used for bone cements, but were weaker on how they were used. A variety of applications were discussed for pLGA, but answers were weak as to how the material was tailored for each application.

Question 10. Hip replacements.

Another very popular question on total hip replacements, with some rather weak answers. In the section concerning the joint reaction force, many candidates could not describe the moments acting around the joint. Most candidates could list three ways to reduce the joint reaction force, but in some cases the description and/or justification was poor. The section describing the advantages and disadvantages of three different metallic alloys was the weakest section of the question, with some candidates confusing modulus and strength. In the final section on the design of the implant, most candidates did consider several aspects but most also left out some of the important aspects.

**DEVICES, MEMORY AND STORAGE**

Question 11. Doping of ceramics.

Generally a reasonably well answered question with well-structured answers, clearly laid out. The section on effective valency was generally well answered. The section on $BaTiO_3$ received more mixed answers, with the doping with Ba ions not very well answered, and the La-doped section lacking details of what is happening in the vicinity of the grain boundaries. The final section on the use of $SnO_2$ for gas sensors was generally well answered.

Question 12. Czochralski and gallium arsenide.

Not a particularly popular question, but there were some good answers. The section on Czochralski growth of gallium arsenide was generally well described with most of the key points included. In the second section on the manufacture of laser diodes from a semi-insulating gallium arsenide ingot, some of the candidates described processes not appropriate to the product.

# REPORT ON FINAL HONOURS SCHOOL OF MATERIALS SCIENCE, PART II EXAMINATION

**Part I**

**A. STATISTICS**

(1) **Numbers and percentages in each category**

Candidates are given a mark on the basis of their performance in the Part II examination and then given a classification on the basis of their performance across Part I and Part II.

| Class | Number | | | Percentage (%) | | |
|---|---|---|---|---|---|---|
| | 2012/13 | 2011/12 | 2010/11 | 2012/13 | 2011/12 | 2010/11 |
| I | 8 | 7 | 9 | 29.6 | 31.8 | 39.1 |
| II.I | 16 | 11 | 8 | 59.3 | 50.0 | 34.8 |
| II.II | 3 | 2 | 6 | 11.1 | 9.1 | 26.1 |
| III | 0 | 2 | 0 | 0 | 9.1 | 0 |
| Pass | 0 | 0 | 0 | 0 | 0 | 0 |
| Fail | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 27 | 22 | 23 | - | - | - |

(2) **The use of vivas**
The Part II examination in Materials Science consists only of a research project, for which a thesis not exceeding 12,000 words, or 100 pages, is produced. Each thesis was read by two internal examiners and one external and the final thesis mark was then agreed. All candidates were given a viva but numerical marks are not given for viva performance. The viva was used to clarify points of detail and to ensure that the thesis presented has been prepared by the candidate being examined.

(3) **Marking of theses**
All theses were double blind marked by two internal examiners, and read by one external examiner. (Due to the small number of candidates, which makes it easy to identify who is working on a particular research topic, anonymous marking is not possible.) Provisional marks were exchanged in advance of the viva, to allow a brief discussion of differences of assessment, which if necessary could be explored further during the viva. Following the viva, a final agreed mark was decided between all the examiners. The two internal examiners who read the thesis and the external examiner provided the greatest input into the decision making process.

**B. NEW EXAMINING METHODS AND PROCEDURES**

None this year.

**C. CHANGES IN EXAMINING METHODS, PROCEDURES AND CONVENTIONS WHICH THE EXAMINERS WOULD WISH THE FACULTY AND THE DIVISIONAL BOARD TO CONSIDER**

Because of the number of Part II theses to examine this year (28), and the restricted time over which to read them, the examiners requested the appointment of an additional assessor, Dr Kyriakos Porfyrakis, to assist with Part II examining. Dr Porfyrakis attended all the viva voce examinations and assisted with the assignment of marks to the projects.

It would have been helpful for Dr Porfyrakis to attend the final board of examiners meeting, at which point the marks were finalized with both external examiners present. It would therefore been helpful to have had Dr Porfyrakis appointed as an examiner, and such a step may be considered by faculty in future years when there are a large number of Part II theses to examine.

Currently, all submitted Part II theses are read by at least one of the external examiners. The increasingly large number of theses is becoming burdensome for the external examiners and may affect our ability to recruit external examiners in the future. Going forward, it may be considered more appropriate for them to review a representative sub-sample, rather than all the theses.

**D. EXAMINATION CONVENTIONS**

The previous year's Examination Conventions were included in the Course Handbook that was distributed to all candidates in hard-copy and was also made available on the Departmental website, to which candidates' attention was drawn by e-mail. The current year's Conventions (2013, attached) were put on the Departmental website and sent electronically to all candidates on 15 March 2013, and in hard-copy for the start of Trinity term. The Examination Conventions were assessed by the Board of Examiners and the Department's Academic Committee.

**Part II**

**A. GENERAL COMMENTS ON THE EXAMINATION**

There were 27 candidates for the examination, who were all awarded Honours. [redacted] The examination required the candidates to submit a thesis (maximum 12,000 words) on a research project carried out by candidates during the year, usually in the Department of Materials. Candidates were given a 25 minute viva, during which they were asked detailed questions on their thesis and research work.

The theses were generally of a very high quality, and the candidates were able to explain their work well in the vivas. As usual, in some cases the vivas became short but in-depth scientific discussions with the candidates. The marks for the Part II examination ranged from 50% to 89%, with an overall mean mark towards the top of the 2(i) range. The external Examiners played an important role in deciding the final marks for the candidates, and the Chairman would like to express his thanks to both of them for their hard work in reading so many Part II theses and contributing greatly to the vivas.

## B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER

Insofar as can be judged from the small sample size, the performance of male and female candidates was not significantly different.

If necessary, where approved by the Proctors, the Examiners took into account the impact of dyslexia and other specific learning difficulties and/or other special arrangements. These allowances seemed satisfactory.

| | Overall mark | | Part 2 Project | | Part I Mark | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 40–50 | - | 1 | - | - | - | 2 |
| 50–60 | 1 | 3 | 2 | - | 2 | 5 |
| 60–70 | 7 | 7 | 7 | 6 | 7 | 4 |
| 70–80 | 6 | 2 | 4 | 7 | 5 | 2 |
| 80–90 | - | - | 1 | - | - | - |
| Totals | 14 | 13 | 14 | 13 | 14 | 13 |

## C. DETAILED NUMBERS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

All candidates took the same examination, producing a thesis and attending a viva. The statistics on the final marks for both Part I (2012) and Part II for these candidates is given above.

## D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

Not relevant for this examination.

## E. COMMENTS ON THE PERFORMANCE OF IDENTIFIABLE INDIVIDUALS AND OTHER MATERIALS WHICH WOULD USUALLY BE TREATED AS RESERVED BUSINESS

One medical note was received [redacted]

| | | | |
|---|---|---|---|
| [redacted] | [redacted] | [redacted] | [redacted] |

.

## F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

| | |
|---|---|
| Prof. P.D. Nellist (Chairman) | Dr H.E. Assender |
| Prof. S.G. Roberts | Prof. T.J. Marrow |
| Dr K.A.Q. O'Reilly | Dr A.A.R. Watt |
| Prof. M.G. Burke (external) | Prof. W.M. Rainforth (external) |

# Examination Conventions 2012/13
# Final Honours School
# Materials Science

## 1. INTRODUCTION

The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. These conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The examiners are nominated by the Nominating Committee* in the Department and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. Formally, examiners are independent of the Department and of those who lecture courses. However, for written papers on Materials Science in Part I examiners are expected to consult with course lecturers in the process of setting questions. The paragraphs below indicate the conventions to which the examiners usually adhere, subject to the guidance of the appointed external examiners, and other bodies such as the Academic Committee in the Department, the Mathematical, Physical and Life Sciences Division, the Education Committee of the University and the Proctors who may offer advice or make recommendations to examiners. It must be stressed that to preserve the independence of the examiners, candidates are not allowed to make contact directly about matters relating to the content or marking of papers. Any communication must be via the Senior Tutor of your college, who will, if he or she deems the matter of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Examiners.

During the marking process the scripts of all written papers remain anonymous to the markers.
[In some of the descriptions of marking for individual elements of coursework that are given later in this document the term ‘double marked, blind,’ is used; this refers to the fact that the second marker does not see the marks awarded by the first marker until he or she has recorded his or her own assessment, and does not indicate that the candidate is anonymous to the markers.]

Marking criteria for the Business Plan, Team Design Project and Part II project are published in the relevant course handbook.

**Late Submission of or Failure to Submit Coursework**
The Examination Regulations stipulate specific dates for submission of the required pieces of coursework to the Examiners (1. One piece of Engineering & Society Coursework; 2. A set of detailed reports of practical work; 3. A Team Design Project Report; 4. Industrial Visit Reports as specified in the course handbook; 5. A report on the work carried out in either the Characterisation of Materials module or the Introduction to Modelling in Materials module; and 6. A Part II Thesis). Rules governing late submission and any consequent penalties are set out in the ‘Late submission of work’ sub-section of the ‘Regulations for the Conduct of University Examinations’ section of the Examination Regulations (pp45-46 of the 2012 Regulations).

Under the provisions permitted by the regulation, late submission of coursework for Materials Science or Materials, Economics & Management examinations will normally result in the following penalties:

(a) With permission from the Proctors under clause (1) of para 16.8 no penalty.

(b) With permission from the Proctors under clauses (3) + (4) of para 16.8, for the first day or part of the first day that the work is late a penalty of a reduction in the mark for the coursework in question of up to 10% of the maximum mark available for the piece of work, and for each subsequent day or part of a day that the work is late a further penalty of up to 5% of the maximum mark available for the piece of work; the exact penalty to be set by the Examiners with due consideration given to any advice given in the Proctors’ “Notes for the Guidance of Examiners and Chairmen of Examiners”.

(c) Where the candidate is not permitted by the Proctors to remain in the examination he or she will be deemed to have failed the examination as a whole.

Where no work is submitted or it is proffered so late that it would be impractical to accept it for assessment the Proctors may, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chairman of the Examiners, permit the candidate to remain in the examination. In this case the Examiners will award a mark of zero for the piece of coursework in question.

* for the 2012-13 examinations the Nominating Committee comprised Prof Grovenor & Dr Taylor.

Penalties for late submission of individual practical reports are set out in the MS/MEM FHS Handbook and are separate to the provisions described above.

## 2. PART I

(1) *Setting of papers*

Part I General Papers 1 – 4 are set by the examiners in consultation with course lecturers. The responsibility for the setting of each examination paper is assigned to an examiner, and a second examiner is assigned as a checker. Option papers are set by lecturers of the option courses and two examiners, the examiners acting as checkers. The examiners, in consultation with lecturers, produce model answers for every question set. The wording and content of all examination questions set, and the model answers, are scrutinised by all examiners, including, in particular, the external examiners.

(2) *Paper Format*

All General papers comprise eight questions from which candidates attempt five. Each question is worth 20 marks. The total number of marks available on each general paper is 100. Materials Option papers comprise one section for each twelve-hour Options lecture course, each section containing two questions: candidates are required to answer one question from each of any three sections and a fourth question drawn from any one of the same three sections. The total number of marks available on each option paper is 100, and all questions carry equal marks. Questions are often divided into parts, with the marks for each part indicated on the question paper.

(3) *Marking of papers*

All scripts are double marked, blind, by the setter and the checker. After individual marking the two examiners meet to agree marks question by question. If the differences in marks are small (~10% of the total available for the question, 2-3 marks for most questions), the two marks are averaged, with no rounding applied. Otherwise the examiners identify the discrepancy and read the answer again, either in whole or in part, to reconcile the differences. If after this process the examiners still cannot agree, they seek the help of the Chairman, or another examiner as appropriate, to adjudicate. An integer total mark for each paper is awarded, where necessary rounding up to achieve this.
Options papers are marked by course lecturers acting as assessors and an examiner acting as a checker. The external examiners provide an independent check on the whole process of setting and marking.
The rubric on each paper indicates a prescribed number of answers required (e.g. "candidates are required to submit answers to no more than five questions"). Candidates will be asked to indicate on their cover sheet which questions, up to the prescribed number, they are submitting for marking. If the cover slip is not completed then the examiners will mark the first five questions in numerical order by question number. The examiners will NOT mark questions in excess of the prescribed number. If fewer questions than the prescribed number are attempted, (i) each missing attempt will be assigned a mark of zero, (ii) for those questions that are attempted **no** marks beyond the maximum per question indicated under section 2(2) above will be awarded and (iii) the mark for the paper will still be calculated out of 100.

As the total number of students is small, it is not unusual for mean marks to vary from paper to paper, or year to year. It is not therefore normal practice to adjust marks to fit any particular distribution. However, where marks for papers are unusually high or low, the examiners may, having reviewed the difficulty of the paper set or other circumstances, decide with the agreement of the external examiner to adjust all marks for those papers. Such adjustment is referred to as ‘scaling’ and the normal procedure will be as follows:

a. Papers with a *mean taken over all candidates* of less than 55% or more than 75% are normally adjusted to bring the *mean* respectively up to 55% or down to 75%. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate’s score for the paper.
b. For papers with a mean in the ranges either of 55-60% or 70-75%, including those scaled under (i) above, the questions and typical answers are compared in order to ascertain, with the help of the external examiners, whether the marks are a fair reflection of the performance of the candidates as measured against the class descriptors. If not, the marks are adjusted. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate’s score for the question or for the paper.
c. The mean mark and the distribution of marks, both taken over all written papers, are considered, again with the help of the external examiners, in order to ascertain whether these overall marks are a fair reflection of the performance of the candidates as measured against the class descriptors. If not, the overall marks are adjusted. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate’s overall score.

(4) *Marking of Second Year Practicals for Part I*

Second year practicals are assessed continually by senior demonstrators in the teaching laboratory and in total are allocated 60 marks. Part I examiners have the authority to set a practical examination.

(5) *Marking Industrial Visits*

Four industrial visit reports should be submitted during Part I. Reports are assessed by the Industrial Visits Academic Organiser on a satisfactory / non-satisfactory basis, and are allocated a total of 20 marks.

(6) *Marking Engineering and Society Essays*

The business plan for “Entrepreneurship and new ventures” is double marked, blind, by two assessors; last year one assessor was from ISIS Innovation and one was appointed by the Faculty of Materials. The business plan is allocated a total of 20 marks.

If the Foreign Language Option or a Supplementary Subject has been offered instead of the Business Plan, the reported % mark, which is arrived at in accordance with the CVCP degree class boundary descriptors, is divided by five to give a mark out of 20.

(7) *Marking the Team Design Project*

The team design project is double marked, blind, by two of the Part I Examiners. They then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each project and each team member. Supervisors of the projects submit a written report to the examiners on the work carried out by their teams and these are taken into consideration when the examiners decide the final agreed marks. Industrial representatives may be asked to contribute to the assessment process. The project is allocated 50 marks, of which 25 are for the written report and 25 for the oral presentation. The same two examiners assess both the reports and the presentations.

(8) *Marking the Characterisation of Materials and the Introduction to Materials Modelling modules*

The reports for these modules are double marked, blind, by the module assessors. Normally, at least one of the two assessors for each report will be a module organizer. The assessors then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each report. The Chairman of Examiners oversees this process, sampling reports to ensure consistency between the different pairs of assessors and the two modules. The lead organizer for the Characterisation Module submits to the Assessors and Examiners of the module a short report which provides, by sample set only, (i) a summary of the availability of appropriate characterization instruments during the two-week module and (ii) any other pertinent information. An analogous report is provided by the lead organizer for the Modelling Module in respect of the software & hardware required for each mini-project. The Report for the Characterisation module is allocated 50 marks and each of the two reports for the Modelling module are allocated 25 marks.

## 3. PART II

The Part II project is assessed by means of a thesis which is submitted to the Examiners, who will also take into account a written report from the candidate's supervisor*****.

The project is allocated 400 marks, which is one third of the total marks for Parts I and II. Two Part II examiners read the thesis, including the project management chapter, together with Part A of the supervisor's report, and each of them independently allocates a provisional mark based on the guidelines****** published in the course handbook. In addition, normally the thesis will be read by one of the two external examiners.

A *viva voce* examination is held: the purpose of the viva is to clarify any points the readers believe should be explored, and to ascertain the extent to which the work reported is the candidate's. An examiners' discussion is held after the viva, involving all Part II examiners, and at which time Part B of the supervisor's report is taken into account. The outcome of the discussion is an agreed mark for the project. In arriving at the agreed mark the Examiners will take into account all of the following, (i) the opinion of the external examiner who has read the thesis, (ii) the candidate's understanding of their work as demonstrated during the viva and (iii) the comments and provisional marks of the original markers. It is stressed that it is the scientific content of the project and the candidate's understanding of their work that is being considered in the viva.
If the two provisional marks allocated in advance of the viva differ significantly (that is, normally by more than 10% of the total available for the project) this will be addressed explicitly during the discussion after the viva. In the majority of other cases the viva has only a small influence on the agreed mark awarded to a Part II thesis.

If there are believed to be mitigating circumstances, such as illness, which may have affected the candidate's progress with the project these should, in the normal way, be drawn to the attention of the Senior Tutor at the candidate's college, who will, if appropriate, inform the Proctors. The Proctors may in turn communicate with the Chairman of Examiners about the mitigating circumstances. Subject to guidance from the Proctors, if appropriate the Board of Examiners will take into account these mitigating circumstances in their discussion after the viva.

***** The Supervisor's report is divided into Parts A & B: Part A provides simple factual information that is of significance to the examiners, such as availability of equipment, and is seen by the two markers before they read and assess the thesis. Part A does **not** include personal mitigating circumstances which, subject to guidance from the Proctors, normally are considered only in discussion with **all** Part II examiners thus ensuring equitable treatment of all candidates with mitigating circumstances. Part B of the supervisor's report provides her/his opinion of the candidate's engagement with the project and covers matters such as initiative and independence; it is not seen by the examiners until the discussion held after the viva.

****** These guidelines may change and candidates are notified of any such changes before the end of Hilary Term of their 4$^{th}$ year.

**External Examiners**

Professor W.M. Rainforth
Department of Materials Science and Engineering
University of Sheffield

Professor M.G. Burke
The School of Materials,
University of Manchester

## 4. CLASSIFICATION

The following boundaries (CVCP) and descriptors (MPLSD) are used as guidelines:

| | |
|---|---|
| Class I Honours 70 – 100 | The candidate shows excellent problem-solving skills and excellent knowledge of the material over a wide range of topics, and is able to use that knowledge innovatively and/or in unfamiliar contexts. |
| Class IIi Honours 60 – 69 | The candidate shows good or very good problem-solving skills, and good or very good knowledge of much of the material over a wide range of topics. |
| Class IIii Honours 50 – 59 | The candidate shows basic problem-solving skills and adequate knowledge of most of the material. |
| Class III Honours 40 - 49 | The candidate shows reasonable understanding of at least part of the basic material and some problem solving skills. Although there may be a few good answers, the majority of answers will contain errors in calculations and/or show incomplete understanding of the topics. |
| Pass 30 - 39 | The candidate shows some limited grasp of basic material over a restricted range of topics, but with large gaps in understanding. There need not be any good quality answers, but there will be indications of some competence. |
| Fail 0 - 29 | The candidate shows inadequate grasp of the basic material. The work is likely to show major misunderstanding and confusion, and/or inaccurate calculations; the answers to most of the questions attempted are likely to be fragmentary only. |

In borderline cases the examiners use their discretion and consider the overall quality of the work the candidate has presented for examination. The external examiner often plays a key role in such cases.

**Part I:**

*Unclassified Honours* – The examiners are required to classify each candidate according to her/his overall average mark in Part I as (a) worthy of Honours, (b) Pass or (c) Fail. A candidate is allowed to proceed to Part II only if he/she has been adjudged worthy of honours by the examiners in Part I. The examiners do not divide the categories further but tutors and students may infer how well they have done from their marks. Candidates adjudged worthy of honours normally proceed to Part II but they may, if they wish and subject to approval from the relevant bodies, leave after Part I in which case an Unclassified Honours B.A. degree will be awarded.

*Pass* – The examiners consider that the candidate is not worthy of honours and therefore will not be allowed to proceed to Part II. The candidate may leave with a B.A. (without honours) or may retake Part I the following year (subject to college approval).

*Fail* – The examiners consider that the candidate is not worthy of a B.A. The candidate either leaves without a degree or may retake Part I the following year (subject to college approval).

**Part II:**

*Classified Honours* – Once marking is completed for both Parts I and II an overall percentage mark is computed for each candidate and classification then takes place. Subject to the requirement that Part II be adjudged worthy of honours (see below), classification is based solely on the overall percentage mark; the candidate's profile of marks from each element of assessment is only taken into account in borderline cases. However, a candidate cannot be awarded an M.Eng. degree unless his/her performance in Part II is adjudged worthy of honours i.e. a candidate must be adjudged worthy of honours both in Part I and in Part II to be awarded the M.Eng. degree. Failure to achieve honours in Part II will result in the candidate leaving with an unclassified B.A. (Hons) irrespective of the aggregate mark.

*Pass* – Notwithstanding the award of unclassified honours in Part I, the examiners consider that the candidate's overall performance is not worthy of an M.Eng. The candidate is listed as a Pass on the class list and is awarded an unclassified B.A. (Hons) on the basis of Part I performance.

*Fail* – The examiners consider that the candidate's overall performance is not worthy of an M.Eng. *and* that the performance in Part II is not worthy of a Pass. The candidate is excluded from the class list but is nevertheless awarded an unclassified B.A. (Hons) on the basis of Part I performance.

- The examiners cannot award unclassified honours on the basis of Part II performance unless permitted to do so by the Proctors.
- Nevertheless, candidates awarded a Pass or a Fail by the Part II examiners leave with an unclassified B.A. (Hons) because they were judged worthy of that in Part I (i.e. their degree is the same as if they had left immediately after Part I).
- In terms of the degree awarded, there is no difference between a Pass and a Fail in Part II. The only difference is whether or not the name appears on the class list.
- Candidates cannot normally retake Part II because the Examination Regulations require that they must pass Part II within one year of passing Part I. This rule can only be waived in exceptional circumstances, with permission from the Education Committee.

**Annex: Summary of marks to be awarded for different components of the MS Final Examination in 2013 (For Part I and Part II students who embarked on the FHS respectively in 2011/12 and 2010/11)**

| | **Component** | **Mark** |
|---|---|---|
| **Part I** | General Paper 1 | 100 |
| | General Paper 2 | 100 |
| | General Paper 3 | 100 |
| | General Paper 4 | 100 |
| | Materials Options Paper 1 | 100 |
| | Materials Options Paper 2 | 100 |
| | Practicals & Industrial visits | 80 |
| | Engineering and Society coursework | 20 |
| | Team Design Project | 50 |
| | Characterisation or Modelling module | 50 |
| *Part I Total* | | *800* |
| **Part II** | Thesis | 400 |
| *Overall Total* | | *1200* |

# REPORT ON FINAL HONOURS SCHOOL OF MATERIALS ECONOMICS AND MANAGEMENT, PART I EXAMINATION

**Part I**

**A. STATISTICS**

(1) **Numbers and percentages in each category**

The Part I Examination in Materials Economics and Management is unclassified. No distinctions are awarded. Since the number of candidates in previous years is less than 6, numerical data is confidential.

| Category | Number | | | Percentage | | |
|---|---|---|---|---|---|---|
| | 2012/13 | 2011/12 | 2010/11 | 2012/13 | 2011/12 | 2010/11 |
| Distinction | n/a | n/a | n/a | n/a | n/a | n/a |
| Pass | 9 | n/a | n/a | 100 | n/a | n/a |
| Fail | 0 | n/a | n/a | 0 | n/a | n/a |

(2) **The use of vivas**

As stated in the Examination Conventions, vivas are no longer used in the Part I examination.

(3) **Marking of scripts**
All scripts were double-blind marked by the Examiners. The full procedures are described in the Examination Conventions.

**B. NEW EXAMINING METHODS AND PROCEDURES**

None this year.

**C. CHANGES IN EXAMINING METHODS, PROCEDURES AND CONVENTIONS WHICH THE EXAMINERS WOULD WISH THE FACULTY AND THE DIVISIONAL BOARD TO CONSIDER**

None this year.

**D. EXAMINATION CONVENTIONS**

The previous year's Examination Conventions were included in the Course Handbook that was distributed to all candidates in hard-copy and was also made available on the Departmental website, to which candidates' attention was drawn by e-mail. The current year's Conventions were put on the Departmental website and sent electronically, along with other information in a letter from the Chair of Examiners to all candidates, on 15 March 2013, and in hard-copy for the start of Trinity term. The Examination Conventions were agreed by the Board of Examiners and the Department's Academic Committee.

Subsequent to this, the Management examiners changed the format of the General Management paper, and this change was not communicated to the Materials examining board. Subsequent discussion led to a further revision that was acceptable to the Materials examiners, but these changes required supplementary information regarding this paper to be sent to MEM Part I candidates on 22 May 2013.

**Part II**

**A. GENERAL COMMENTS ON THE EXAMINATION**

There were 9 candidates for the examination. The examination consisted of 7 written papers plus coursework that included a team design project, industrial visit reports and practical work carried out during the 2$^{nd}$ and 3$^{rd}$ year. One of the written papers (Introductory Economics) is taken in the 2$^{nd}$ year.

The written papers consisted of 4 Materials papers, 2 Economics papers and 1 Management paper, each of which lasted 3 hours. For the Materials papers, candidates were required to answer 5 questions out of 8, as in previous years. The Economics and Management Examiners followed their usual procedures. Team design projects were marked by two Examiners, including the Chairman. Teams were marked as groups. The allocation of bonus or penalty marks is permitted under the Conventions, but was not used. Reports for each of the Industrial Visits were assessed as pass/fail by the Industrial Visits Organiser, appointed as Assessor.

The overall mean mark for Part I (MS and MEM) was in the middle of the 2(i) band. All MS and MEM general papers and option papers results were considered. Despite a rather low overall mean mark, the distribution of marks was distinctly bimodal, with some high marks. After extensive discussion of the examiners, it was agreed that the papers were fair, and the mark was being pulled down by weak performances by some candidates. Of particular concern were apparent weaknesses in the areas of mechanical properties of materials and metallurgy.

**B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER**

There were nine candidates: 2 females and 7 males. With these small numbers, the breakdown of the results by gender is confidential (see Section E).

**C. DETAILED NUMBERS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION**

All candidates took the same papers for the whole examination.

**D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS**

Detailed comments on the written examination papers and overall candidates' performance on individual questions are attached.

**E. COMMENTS ON THE PERFORMANCE OF IDENTIFIABLE INDIVIDUALS AND OTHER MATERIALS WHICH WOULD USUALLY BE TREATED AS RESERVED BUSINESS**

(1) **Breakdown of the results by gender**

| | Overall mark | | Written Examinations | | Coursework | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 40–50 | - | [redacted] | - | [redacted] | - | [redacted] |
| 50–60 | 1 | [redacted] | 1 | [redacted] | - | [redacted] |
| 60–70 | 6 | [redacted] | 6 | [redacted] | 1 | [redacted] |
| 70–80 | - | [redacted] | - | [redacted] | 6 | [redacted] |
| 80–90 | - | [redacted] | - | [redacted] | - | [redacted] |
| Totals | 7 | 2 | 7 | 2 | 7 | 2 |

The performance of the male and female candidates was as follows:
Written Papers Averages – M 62.67, F [redacted]% (Overall [redacted]%)
Coursework Averages – M 73.39%, F [redacted]% (Overall [redacted]%)
Overall Part I Averages – M 64.24%, F [redacted]% (Overall [redacted]%)

**F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS**
**MEM:**

Prof. P.D. Nellist (Chairman)

Dr H.E. Assender

Prof. T.J. Marrow

Dr K.A.Q. O'Reilly

Prof. S.G. Roberts

Dr A.A.R. Watt

Dr D.N. Barron (Management)

Prof. R. Westbrook (Management)

Dr O. Darbishire (Management)

Dr J.E. Thanassoulis (Economics)

Dr A.W. Beggs (Economics)

Prof. M.G. Burke (External)

Prof. W.M. Rainforth (External)

Prof. S.M. Wood (External, Management)

Dr H. Simpson (External, Economics)

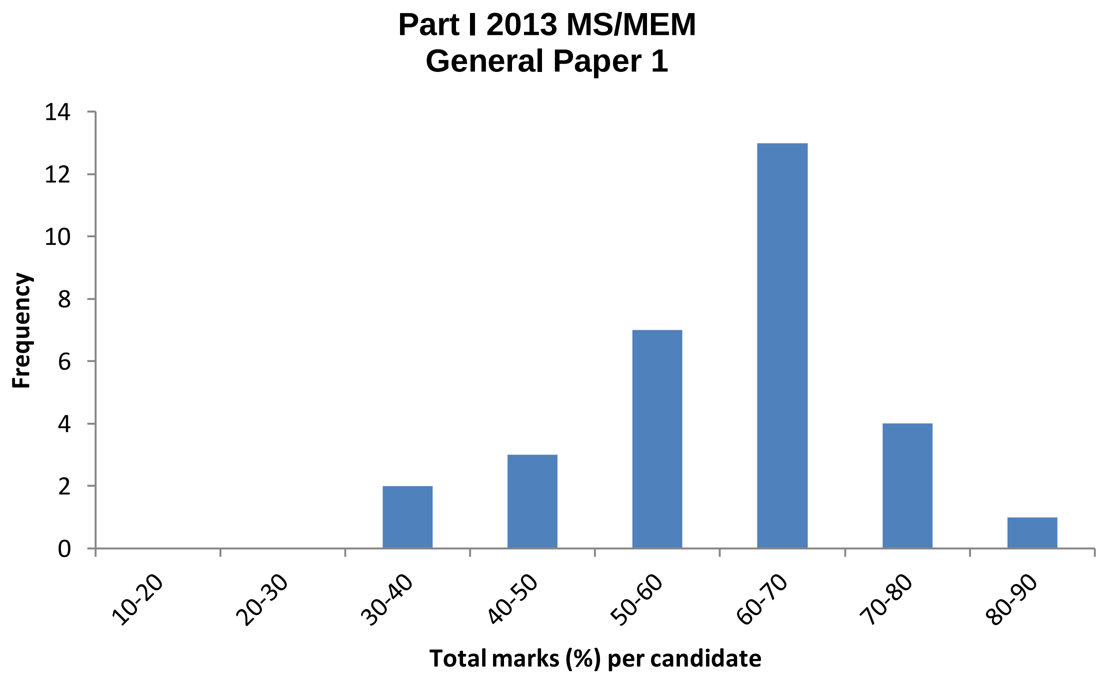
**Attachments**: Examination Conventions 2012/13 FHS Materials, Economics & Management
Comments on General Paper 1
Comments on General Paper 2
Comments on General Paper 3
Comments on General Paper 4
Comments on Economics papers
Comments on General Management paper

## General Paper 1 – Structure and Transformations

**Examiner:** **Prof. James Marrow**
**Candidates:** **30 (21 MS / 9 MEM)**
**Mean mark:** **61.57%**
**Maximum mark:** **84%**
**Minimum mark:** **37%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 28 | 12.21 | 17 | 7 | Phase Transformations |
| 2 | 16 | 12.44 | 16 | 4 | Phase Transformations |
| 3 | 20 | 13.35 | 18 | 5 | Ternary Phase Diagrams |
| 4 | 26 | 13.58 | 19 | 5 | Diffusion |
| 5 | 17 | 12.06 | 18 | 6 | Surfaces and Interfaces |
| 6 | 21 | 11.19 | 18 | 7 | Corrosion |
| 7 | 9 | 9.67 | 13 | 4 | Powder Processing |
| 8 | 13 | 11.69 | 15 | 6 | Microstructure of Polymers |



**General Comments:**

Question 1

d) Generally aware of effects of temperature on driving force and kinetics, and many introduced the Gibbs-Thomson effect. Majority did not use the concept of growth rate dependence on radius to explain how this gave similar size dendrites, not how dendrites could shrink.

e) Most derived the equation and stated assumptions (with some ambiguous solutions), but many did not define variables or give explanation of difference from equilibrium in much depth.

f) Common error was not to give any relation that could be used to estimate time for homogenisation, but generally well done.

Question 2

d) Generally well answered, though generally not noting effects of nucleation site density on phase growth rate by lateral growth, nor constant rate controlled by thermodynamic driving force for continuous growth rate.

e) Qualitatively answered by most, majority missed explanation of how the position dependent energy was overcome by undercooling.

f) (i) Most did not explain why spiral pitch depends on delta T due to Gibbs-Thompson effect, (ii) Generally good, but explanations of the high nucleation energy of step not clearly given, (iii) generally well answered by those who identified solute drag.

Question 3

c) Some students did not explain clearly the role of equilibrium tie-lines (or mention them at all), and most seemed unaware of how phase boundaries are obtained experimentally, i.e. from cooling experiments.

d) (i) and (ii) done well by all, (iii) quite variable. Most did not give any information on how they had arrived at their diagram.

Question 4

e) Generally well done by those who recalled the basic concepts of substitutional diffusion, though many neglected entropy from the start of the derivation.

f) Most understood the difference between the polymer diffusion mechanisms, but answers were lacking in detail.

g) Generally well answered

h) Generally good, though some did not explain why higher order terms decayed more rapidly, and lacking mathematical descriptions.

Question 5

e) Some did not explain the mechanisms of surface creation in liquids and solids.

f) Generally lacking in detail, particularly the ratio of the surface unit cell to the bulk termination cell, with lack of detail in the quoted examples.

g) Few explained the relative differences of the planes, most understood how to construct the equilibrium shape.

h) Concept of construction to obtain the energy ratio understood by most, but many errors in basic trigonometry.

Question 6

e) Most identified cathodic protection, but answers lacked detail. Many did not consider paint as an additional requirement for areas above the water line.

f) Most identified the passive film and anodisation as suitable processed.  Level of detail to explain this varied.

g) Inhibition by passivation identified by most, reasonably detailed answers though some lacked focus on optimum solution for this system and how it may fail.

h) Not well answered by most, with lack of consideration for the actual environmental effects (wet/dry cycles) and practicality of protecting this component.

Question 7

e) Generally good quality “textbook” answers, but some discussed stages of sintering rather than mechanisms.

f) Few mentioned the physics that leads to sintering diagrams, nor described how they may vary, with powder size for example.

g) Answers not well organised – few noted that pre-alloyed powder is less-soft and ductile than elemental powders, nor identified the consequences of this.

h) None provided the required answer – “liquid phase sintering”

Question 8

c) Level of detail in answers could be greater, including size of spherulites and methods for controlling size other than cooling rate.

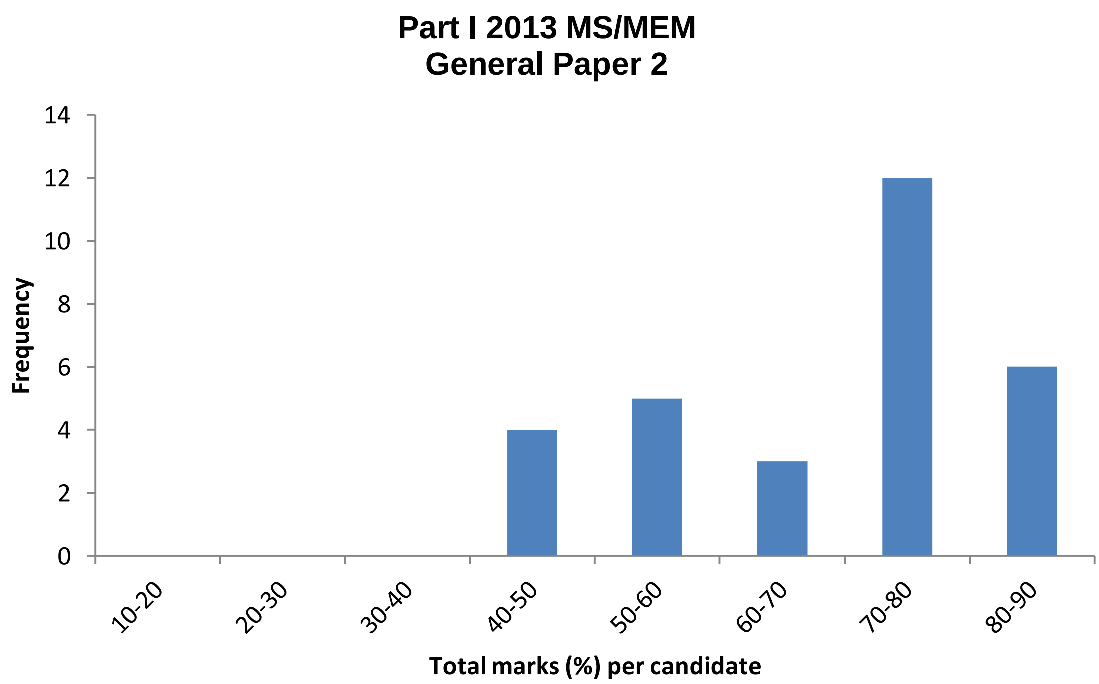
d) Most were not able to relate the calculated periodicity to specific features of the structure of a semi-crystalline polymer.  Confusion about the difference between wide angle and small angle experiments.

## General Paper 2 – Electronic Properties of Materials

**Examiner:** **Prof. Peter Nellist**
**Candidates:** **30 (21 MS / 9 MEM)**
**Mean mark:** **69.90%**
**Maximum mark:** **90%**
**Minimum mark:** **42%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 26 | 14.73 | 19.5 | 3.5 | Electronic structure |
| 2 | 17 | 16.18 | 19 | 13 | Electronic structure |
| 3 | 26 | 15.87 | 20 | 10 | Tensor properties |
| 4 | 9 | 9.67 | 13 | 4 | Quantum mechanics |
| 5 | 29 | 13.64 | 19.5 | 3 | Statistical mechanics |
| 6 | 20 | 12.85 | 17 | 7 | Magnetic properties |
| 7 | 8 | 6.88 | 11 | 2.5 | Semiconductors |
| 8 | 15 | 14.37 | 18.5 | 8 | Electrical properties |



## General Comments:

The average mark for this paper was encouragingly high, though the distribution of marks was distinctly bimodal. Candidates who were confident with the more mathematical and numerical questions scored highly through being able to select the relatively straightforward questions, with weaker candidates suffering. Overall, however, the scripts displayed a high degree of ability and understanding in the topics covered by this paper.

Question 1 on electronic structure was very popular with a high average mark. Although it was a relatively straightforward question, it did require a good knowledge of the key quantities associated with the free-electron model. A common problem was the lack of, or incorrect, units, for example when quoting a density of states.

Question 2 on tight-binding theory in electronic structure was a little less popular, but with a high average mark, perhaps resulting from a degree of self-selection. For what has been historically an unpopular topic, it was answered confidently by many. Typical errors included not identifying the Brillouin zone and not giving numerical values when asked.

Question 3 on tensor properties was a popular and high average mark question. It was a reasonably standard Mohr’s circle question, but did require some thought regarding why the result was independent of strip width. It was in converting field to potential that most errors occurred.

Question 4 quantum mechanics was a more discursive question with only a small component of numerical work. It was quite an unpopular question, with a low average mark. Typical errors included not mentioning diffraction in part (a)(i) not mentioning a single valued wavefunction in (a)(ii) and using a formula appropriate only for photons in part (b).

Question 5 was a question on the statistical mechanics associated with magnetic polarisation of a material, which should be well familiar to candidates. It was a very popular question with a large spread of marks showing good discrimination. Many errors were simply leaving out parts that were asked for, such as the examples in (a)(i and ii) and the actually value of the probability in part (b)(ii).

Question 6 was quite a popular question, with a good average mark. Part (b) was generally answered well, with the more discursive part of (a) causing some problems and a distinct lack of knowledge about how to handle the quantities given in part (c).

Question 7 was an unpopular and poorly scoring question on carrier densities in semiconductors. Although it was in an area that should be familiar to students, I suspect that it was answered by weaker students, with part (b) in particular causing difficulties.

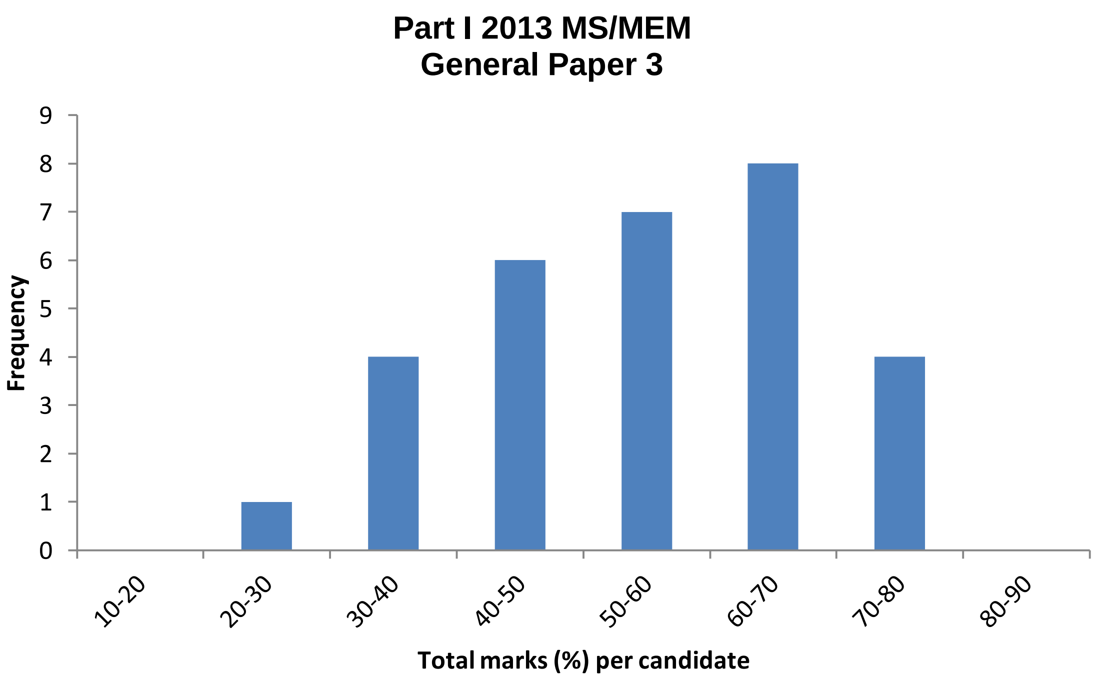
Question 8 was a more discursive question on superconductors. Most answers showed a good knowledge in this area.

## General Paper 3 – Mechanical Properties

**Examiner:** **Prof. Steve Roberts**
**Candidates:** **30 (21 MS / 9 MEM)**
**Mean mark:** **55.73%**
**Maximum mark:** **79%**
**Minimum mark:** **26%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 28 | 11.57 | 19 | 3 | Elasticity |
| 2 | 20 | 11.05 | 18 | 2 | Polymers; elastomer mechanics |
| 3 | 25 | 8.36 | 12 | 3 | Microplasticity; hardening mechanisms |
| 4 | 7 | 12.00 | 16 | 4 | Microplasticity; dislocation mechanics |
| 5 | 16 | 8.31 | 17 | 1 | Macroplasticity |
| 6 | 24 | 13.00 | 18 | 6 | Fracture |
| 7 | 19 | 12.58 | 17 | 5 | Composites; toughness |
| 8 | 11 | 12.73 | 18 | 6 | Creep |



## General Comments

A very wide spread of marks, with the average mark for the paper and for each question brought down by some very poor answers. In quite a few cases, the poor answers were not ones where the candidate had written very little, but where an answer completely missed the point of the question or was just wrong. The internal and external examiners carefully re-examined the paper, and concluded that the paper as a whole, and each question on it, was fair and at an appropriate level. This view was reinforced by the significant number of good or very good answers to each question.

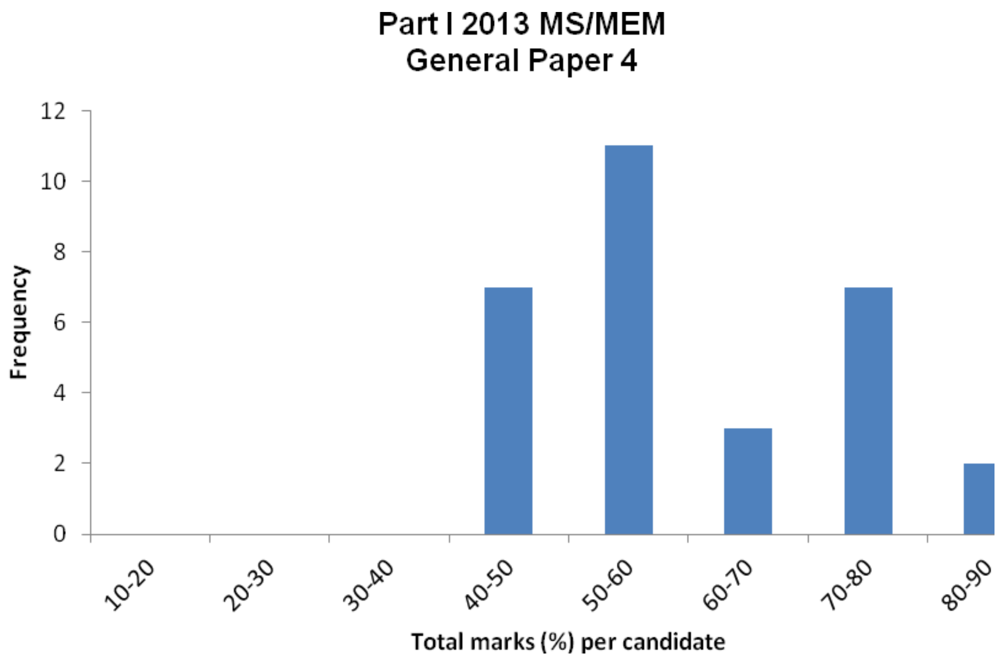
1) Elasticity: A “standard” question, with over half the marks to be gained by easy prelims level stuff, and a core “book work”. The problem was straightforward: only the last three marks needed real thought, realising that shear stress is the critical parameter. Even so, there were only a few good answers. Failures were various: inability to do simple calculus or algebra, inability to see (easy) boundary conditions, radius/diameter confusion… A few candidates misunderstood pretty well everything.
2) Polymers; elastomer mechanics: Popular, but on the whole not well done. Many did not do what (b) asked, but wrote generally, and often inaccurately, about elastomers; (c) was often well done in terms of algebra, but without explanation. In (d), the contribution of bond-stretching was generally missing, though many described alignment of polymer chains. There were some wildly wrong answers, showing next to no knowledge of the topic.
3) Microplasticity; hardening mechanisms: Considering the concepts being explored here were very basic, the general level of understanding was very poor. Most of this was first-year material, expanded in the second year course. Common errors included: not converting lattice parameter to atomic radius (all but one student), electrical charge interactions between solutes and dislocations in metals, dislocations bowing around solute atoms (or cutting them…).
4) Microplasticity; dislocation mechanics: Unpopular: divided those who did it into those who basically knew their stuff (the majority), and those who didn’t at all. In (b), few supported their answers with estimates of the order of magnitude changes in dislocation density with strain, and explanations were limited in detail. In (c), surprisingly all but one candidate went for the Lomer-Cottrell lock in FCC, which is the most difficult possibility. No one could get the crystallography to work out, and no-one gave any explanation of the energetics of lock formation.
5) Macroplasticity: As expected, this question distinguished between those who genuinely understood the principles behind “proofs” gone through in lectures, and those who didn’t, but could rote-learn them. Credit was given for plausible (if not really germane) explanations, but even so average marks were very low.
6) Fracture : A relatively easy question, as part (b) and (c) were very straightforward: only a few lost marks there, often by confusing units. In part (a), the arguments were very often not made clearly, with lots of talking around the topics without getting to a conclusion: none gave a clear explanation (such as a diagram) of how changes to toughness and yield stress would affect the DBTT, and in the worst cases answers were simply wrong.
7) Composites; toughness: Parts (a) and (b), which included some explanation, were variably well done: students were more comfortable on part (c), which was just rote-work. Marks were deducted for not explaining “derivations”.
8) Creep: “Proofs” in part (b) were done mostly well, marks were deducted for not explaining the process. Part (a) was done variably well; this and (c) differentiated between those who really knew their stuff and those who didn’t.

## General Paper 4 – Engineering Applications of Materials

**Examiner:** **Dr Hazel Assender**
**Candidates:** **30 (21 MS / 9 MEM)**
**Mean mark:** **61.23%**
**Maximum mark:** **86%**
**Minimum mark:** **43%**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 26 | 11.77 | 17 | 3 | Microstructural Characterisation |
| 2 | 27 | 12.93 | 18 | 7 | Microstructural Characterisation |
| 3 | 9 | 12.22 | 17 | 9 | Polymers |
| 4 | 2 | 9.50 | 12 | 7 | Ceramics and glasses |
| 5 | 24 | 12.17 | 17 | 7 | Ceramics and glasses |
| 6 | 23 | 13.04 | 18 | 6 | Semiconductor Devices |
| 7 | 16 | 9.44 | 16 | 2 | Engineering Alloys |
| 8 | 22 | 14.09 | 19 | 9 | Engineering Alloys |



## General Comments

A cluster of strong, and a second cluster of weak marks, with a reasonable average mark.

**Question 1:** *TEM imaging.*
A popular question with a modest mean mark. (a) Generally good responses on the bookwork on aberration sources, albeit with some loose descriptions, but the second part on astigmatism was poorly answered (most did not consider how it could be corrected). (b) Many candidates did not get all the steps in this calculation e.g. remembering the bcc criterion, and several used the expression for spherical aberration. In many cases the candidates did not appear to have a clear understanding of the geometry/problem. A significant number of candidates did not attempt the second part of the question on ultimate resolution. (c) Many non-attempts to this section. Several used numerical aperture instead of Bragg angle despite this question being related to lattice imaging rather than diffraction contrast.

**Question 2:** *SEM*.
The most popular question, attempted by all but three candidates, with a reasonably good mean mark. (a) Generally well answered, with occasional confusion between SE and BSE. Where marks were lost, it was usually in not knowing the electron energies. (b) Lots of good answers. (c) The weakest section of the question: most candidates had the basic idea of magnification in the SEM, but were considerably weaker on TEM. Several candidates confused resolution with magnification and few correctly identified the adjustment needed for TEM high magnification.

**Question 3:** *Conjugated polymers and NLO's*.
As anticipated for a question on a topic not appearing in exams previously, this was not a popular question, but the mean mark was around the average for the paper. (a) There was often difficulty describing the bond arrangement leading to delocalisation. (b) A significant proportion of candidates did not address the first sentence of the question and no-one explained why (without bond length resonances included) the delocalised electrons would be expected to lead to metallic behaviour. Conduction mechanisms were well-described. (c) Few candidates could address this section of the question. Credit was lost in being unable to link the equation back to frequency doubling in _some_ component of the light. (d) Advantages and disadvantages of polymers as NLO's were generally well described, but a significant proportion of candidates could not link high polarizability with conjugated chains.

**Question 4:** *Cement*.
A very unpopular question. (a) Reactions were OK, but candidates needed to consider the differences between the various starting components. (b) Poor microstructural descriptions. (c) Poor origins of porosity, but good on removal routes. (d) mixed response.

**Question 5:** *Sintering and Weibull modulus.*
Popular question. (a) Generally good answers. The best marks were awarded to candidates who could describe where the fundamental difficulties with residual porosity were discussed in terms of diffusive processes during sintering. (b) Generally well answered, although some examples were given that would have a relatively minor impact on porosity. (c) Some candidates appeared to forget the first part of this section (defining the terms). Many struggled with the Weibull calculation, although most could outline the methodology. Most difficulty was had in determining the probability of survival. (d) Very poorly answered section, requiring thinking about the experiment, with few marks awarded.

**Question 6:** *Solar cell pn junctions*.
Popular question with a high mean mark. (a) Generally well answered. Most candidates could draw the band diagram of the pn junction and give a good discussion of the general diode behaviour, but marks were lost in the careful consideration of the balance of drift and diffusion currents. (b) Generally well answered. Most candidates could explain about the maximum power operation point well. Often the consideration of the short and open circuit conditions was limited to statements that there is no voltage and current respectively. (c) A challenging part of the question. Many candidates could identify basic cell design issues such as having an appropriate band gap, but were less able to identify materials issues that limit efficiency in existing solar cell technology (e.g. recombination). (d) A spread of scores in this section. Nearly all candidates mentioned that the different semiconductors can absorb light at different wavelengths for some credit, but many then did not describe how they were combined to lead to higher efficiency.

**Question 7:** *Ti-Al-V and beta Ti alloys.*
Not a very popular question, with the weakest mean mark. (a) Answers were often disappointingly confused about the desirable microstructures for the different properties. Most candidates could explain the α-β structure and phase behaviour. A frequent weakness was the description of the process history. (b) The main weakness was again describing the processing of these alloys. Some candidates did not consider the possibility of α-phase formation. Answers were stronger on properties and applications.

**Question 8:** *Eutectoid and hypoeutectoid steels.*
A reasonably popular question attracting the highest mean mark. (a) Generally very well answered. A few candidates did not describe a return to the austenitic phase for part (ii). (b) The most challenging section of this question. A significant number of candidates did not discuss bainite at all, and several lost marks for not describing microstructure (just listing phases/crystallography) or mechanical properties. (c) Generally well answered.

## Examiners' Report for MEM 2013 – Economics Papers

**Part I**

9 candidates sat the **Introductory Economics** paper (compared to 1 the previous year) in 2012. The paper is also taken by as Prelims paper by PPE and E&M candidates and a detailed report can be found in the 2012 PPE examiners' report. MEM scripts were double marked.

The candidates sat the **Microeconomics** paper in 2013. The paper was identical to the Finals' paper sat by E&M and PPE candidates. A detailed report can be found in the PPE Finals' examiners report.

Alan Beggs

# Examiners’ Report for MEM 2013 – Management Papers

**Examination Report**
**General Management**
**Trinity Term 2013**

**General comments**

The overall standard of scripts was good, with most candidates achieving 2.1 level marks and a substantial number reaching first class standard on individual answers. With very few exceptions, it was clear that the students had engaged with the tutorials at a very good level, and understood the key learning objectives that had been set forth.

There was some variability in candidates’ focus on the examination questions, with a disappointing number of students simply reproducing tutorial essays rather than answering the question that was set. The importance of answering the examination question cannot be emphasized enough. Other students lost marks by simply reproducing evidence from the readings or elsewhere, without providing arguments to show why they were relevant to their answers. Finally, although students had clearly mastered the most popular core tutorial readings, and some went well beyond in the tutorial reading lists, they could have taken advantage also of the classic and textbook readings to underpin their answers more firmly. In a few thankfully rare cases, students failed to show that they had a grasp of the material and simply answered from common knowledge.

**Specific questions**

**1. (Professional service firms)**

(Number answering = 14) Many students chose to restrict their discussion of professional service firms to management consulting only, while better answers drew on more than one type. Arguments ranged from the instrument (simple provision of services) to the theoretical (role in institutions and diffusions of fads/fashions).

**2. (Global brand value)**

(Number answering = 37) This was one of the most popular questions, but not one of the best answered. The majority of candidates tended to deliver only slightly varied forms of the tutorial essay on branding, focusing either on ‘brand value’, or on ‘cultural differences across markets’. Some of the better essays discussed aspects such as returns to scale or risks to the global brand from local scandals, including damage from unethical production processes as well as distribution activities. A few answers digressed into a study of consumption, without relating it to the question.

**3. (Relevance of business history)**

(Number answering = 13) There were some strong answers on this issue, but also some answers that merely recounted ‘anything the candidate knew about business history’ without more than superficially addressing its relevance for contemporary executives.

**4. (Power relations and innovation)**

(Number answering = 34) Some students restricted their answers to a rote recitation of the power, focusing on the definition of power and its sources. Better answers accounted for the ways in which power could be used to facilitate or inhibit innovation, whilst the best answers recognized that power is not strictly top-down and serves vested interests.

**5. (Culture and corporate governance)**

(Number answering = 38) Students generally described corporate governance, although some struggled with its definition. Some answers took culture to refer to corporate culture, and described how it could be used to control firms’ behaviour, whilst others took culture to refer to national culture, and described how systems of corporate governance reflected the larger political, economic, and social systems in which they were embedded.

**6. (Variation in production systems)**

(Number answering = 6) Better answers to this question explained the role of flexibility in response to variability (in customer demand etc.), whilst disappointingly few drew on the readings, for example the Hayes and Wheelwright framework in the classic readings (and the Slack textbook readings).

**7. (Ecological theory of organisations)**

(Number answering = 3) This was the least popular question, with only a minority of candidates attempting this question. Stronger candidates competently handled the definition of ecological theory and related it to entrepreneurship. Weaker candidates had no idea what ecological theory was and attempted unsuccessfully to bluff their way through, rather than focusing on the relationship between organisations and environments to illustrate the points made.

**8. (Global business)**

(Number answering = 16) On the whole well answered; the question could be successfully taken in more than one direction, e.g. by deeper discussion of Anglo-American versus other systems of corporate governance, or of the impact of differences in national culture on global business. Both options were rewarded if clearly done. Popular; generally well handled with some exceptionally strong answers that picked up well on the issue.

**9. (Middle management)**

(Number answering = 5) This was an unpopular question, surprisingly, given the material available on the reading list. The key was to define a MIDDLE manager (a manager who is managed by a manager and is a manager of other managers) and then think about the scale of organization necessary to employ middle management and how very large organisations have changed over time given technology, economic scale, and managerial knowledge.

**10. (Consumers versus consumption)**

(Number answering = 2) Relatively few students answered this question Most answers drew on Vargo and Lusch and described how marketing had evolved over time. The better answers provided a more nuanced description of marketing relationships.

**11. (Inventory)**

(Number answering = 8) This was a “classic” question which drew on an understanding of operations management in general and the Toyota Production System (particularly just-in-time) in particular. Students recognized the value of inventory as a buffer, and the costs of holding inventory in general, but did not make the obvious link to quality and continuous improvement from the readings.

**12. (Organisations)**

(Number answering = 5) Another question that was attempted by relatively few students. A few students drew on contingency theory and other frameworks to explain isomorphic pressures, whilst other simply waffled on about metaphors of organisations.

**PART B**

**13. (Ethics of managers)**

(Number answering = 11) Similar to Question 5, some students chose to interpret culture as organizational culture, whilst other opted for national culture. Nearly all students correctly noted that norms differ across national cultures, but relatively few then followed through with a discussion of how this might be assessed, and only a small number brought in the ethical frameworks that could be applied.

**14. (Professions and operations management)**

(Number answering = 19) Students brought a relatively sound understanding of the professions to this question, although as with Question 1, this was often limited to management consulting. Many derived a fairly sophisticated argument against taking a “production-line” or “McDonaldisation” approach to client-facing services, although not all recognized that operations management is not limited to “mass production” and that aspects of professional services could benefit from operations management, especially routine-back office processes.

**15. (Corporate strategy versus the supply chain)**

(Number answering = 43) Students who attempted this often did not properly contrast the first statement (that strategy is an excuse to lose money) against the second (that the supply chain is the real means). The key to any contrasting statement like this is to properly explain the two assertions and then evaluate them both independently and in contrast. Students often skipped by the first statement to evaluate the second, losing sight of the time dimension, the differential expertise, and the implicit issue of power raised in the comparison.

**16. (Marketing)**

(Number answering = 45) This was one of the two most popular questions in Part B. The examiners expected that candidates would be led to discuss whether market research met the criteria of science, and compare the marketing perspective with the consumption perspective, and relate this to the larger question of whether management is a science or art. Large numbers of essays instead discussed the historical development of marketing and claimed that this disqualified marketing from being a science. We marked on the basis that an historical approach was acceptable if candidates displayed detailed understanding of the development and related it to the methods and approaches of science. Weaker candidates tended to give incomplete accounts of both marketing and/or science. A disappointing number of candidates made factual mistakes such as misunderstanding Popper's falsifiability.

**17 Can organisations think?**

(Number answering = 22) Although relatively few students answered this question, those who did provided mostly thoughtful answers, with some overuse of Morgan's "brain" analogy without answering the question. Students brought in decision-making and other functions, but needed to bridge individual-level actions with collective properties, rather than taking emergence for granted.

**18. Economics is timeless, while management is driven by fads and fashions.**

(Number answering = 40) There was some tendency for candidates to attempt this as the last question and for answers to be somewhat scrappy as a result. Some candidates took issue with both parts of the question, but mistook "timeless" in the first part for "unchanged over time". The better answers recognized both the changing context of management knowledge and the extent to which there were vested interests in the "fads and fashions" lifecycle.

**STATISTICS**

| GENERAL MANAGEMENT (MEM) | |
|---|---|
| | Examination |
| Mean Mark | 61.7 |
| Highest mark | 69 |
| Lowest mark | 53 |

# REPORT ON FINAL HONOURS SCHOOL OF MATERIALS ECONOMICS AND MANAGEMENT, PART II EXAMINATION

**Part I**

**A. STATISTICS**

(1) **Numbers and percentages in each category**
Candidates are given a mark on the basis of their performance in the Part II examination and then given a classification on the basis of their performance across Part I and Part II. Since the number of candidates in this and previous years is less than 6, numerical data is confidential (see section E, below).

(2) **The use of vivas**
Vivas were not used for this Examination.

(3) **Marking of scripts**
All scripts were double-blind marked by the Examiners and Assessors. The full procedures are described in the Examination Conventions.

**B. NEW EXAMINING METHODS AND PROCEDURES**

None this year.

**C. CHANGES IN EXAMINING METHODS, PROCEDURES AND CONVENTIONS WHICH THE EXAMINERS WOULD WISH THE FACULTY AND THE DIVISIONAL BOARD TO CONSIDER**

None this year.

**D. EXAMINATION CONVENTIONS**

The previous year's Examination Conventions were included in the Course Handbook that was distributed to all candidates in hard-copy and was also made available on the Departmental website, to which candidates' attention was drawn by e-mail. The current year's Conventions were put on the Departmental website and sent electronically, along with other information in a letter from the Chair of Examiners to all candidates, on 15 March 2013, and in hard-copy for the start of Trinity term. The Examination Conventions were agreed by the Board of Examiners and the Department's Academic Committee.

**Part II**

**A. GENERAL COMMENTS ON THE EXAMINATION**

There was 1 candidate for the examination. The examination consisted of 2 written papers, one being a compulsory Materials Options paper, and the other paper being selected from a range of Economics and Management options. For the Materials Options paper, candidates were offered 12 questions in 6 sections each containing 2 questions; candidates were required to answer 4 questions, 1 from each of three sections and 1 from any of the same three sections.

In addition to the written papers, candidates are required to submit a report on a 24-week industrial placement, which has the weight of 2 written papers. The reports on these 24-week Management projects are marked by staff at the Said Business School. For reasons of anonymity, the details of the overall mean marks are discussed in Section E, below.

**B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER**

Due to the small number of candidates for this examination, the numerical data is confidential (see section E, below).

## C. DETAILED NUMBERS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

Due to the small number of candidates numerical data is confidential (see section E, below).

## D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

Detailed comments on the written examination papers and overall candidates' performance on individual questions are attached.

## E. COMMENTS ON THE PERFORMANCE OF IDENTIFIABLE INDIVIDUALS AND OTHER MATERIALS WHICH WOULD USUALLY BE TREATED AS RESERVED BUSINESS

For reasons of anonymity, the details of the overall mean marks are discussed in this section. For Parts I and II combined the average mark was [redacted].

(1) **Numbers and percentages in each category**
Candidates are given a mark on the basis of their performance in the Part II examination and then given a classification on the basis of their performance across Part I and Part II. There was 1 candidate for the examination, [redacted].

| Class | Number | | | Percentage (%) | | |
|---|---|---|---|---|---|---|
| | 2012/13 | 2011/12 | 2010/11 | 2012/13 | 2011/12 | 2010/11 |
| I | [redacted] | 2 | [redacted] | [redacted] | 33 | [redacted] |
| II.I | [redacted] | 4 | [redacted] | [redacted] | 66 | [redacted] |
| II.II | [redacted] | 0 | [redacted] | [redacted] | 0 | [redacted] |
| III | [redacted] | 0 | [redacted] | [redacted] | 0 | [redacted] |
| Pass | [redacted] | 0 | [redacted] | [redacted] | 0 | [redacted] |
| Fail | [redacted] | 0 | [redacted] | [redacted] | 0 | [redacted] |

(2) **Breakdown of the results by gender**

| | Overall mark | | Part 2 Mark | | Part 1 Mark | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 0 - 40 | [redacted] | - | [redacted] | - | [redacted] | - |
| 40–50 | [redacted] | - | [redacted] | - | [redacted] | - |
| 50–60 | [redacted] | - | [redacted] | - | [redacted] | - |
| 60–70 | [redacted] | - | [redacted] | - | [redacted] | - |
| 70–80 | [redacted] | - | [redacted] | - | [redacted] | - |
| 80–90 | [redacted] | - | [redacted] | - | [redacted] | - |
| Totals | 1 | - | 1 | - | 1 | - |

(3) **Candidates' Performance in each part of the examination**

The candidate sat the Materials Options paper, [redacted]. In addition, the candidate sat the Accounting paper, achieving [redacted].

(4) **Equal Opportunities issues**
There were no female candidates and no candidates with declared disabilities.

## F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

**MEM:**

Prof. P.D. Nellist (Chairman)

Dr H.E. Assender

Prof. T.J. Marrow

Dr K.A.Q. O'Reilly

Prof. S.G. Roberts

Dr A.A.R. Watt

Dr D.N. Barron (Management)

Prof. R. Westbrook (Management)

Dr O. Darbishire (Management)

Dr J.E. Thanassoulis (Economics)

Dr A.W. Beggs (Economics)

Prof. M.G. Burke (External)

Prof. W.M. Rainforth (External)

Prof. S.M. Wood (External, Management)

Dr H. Simpson (External, Economics)

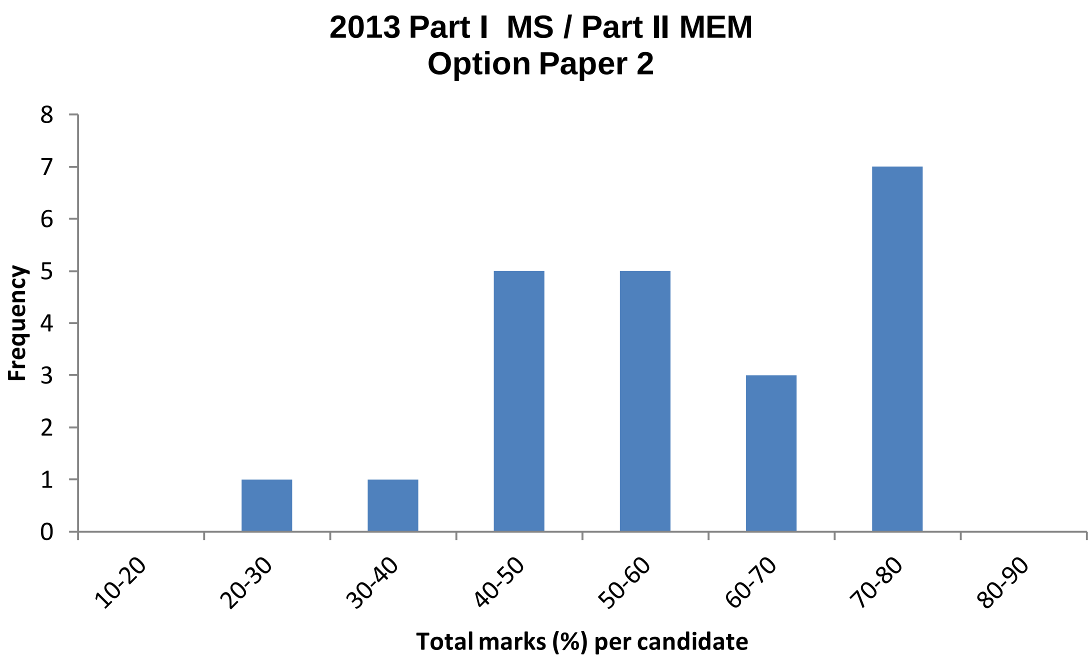
**Attachments**: Examination Conventions 2012/13
Comments on Materials Option Paper 2
Comments on Economics paper

## Materials Options Paper 2

**Examiner:** Dr Keyna O'Reilly
**Candidates:** 22 (21 MS / 1 MEM)
**Mean mark:** 59.27%
**Maximum mark:** 80%
**Minimum mark:** 29%

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 8 | 14.00 | 17 | 10 | Polymer interfacial fracture energy |
| 2 | 7 | 17.57 | 21 | 13 | Polymer analysis techniques |
| 3 | 3 | 15.00 | 16 | 13 | Steels and cast irons |
| 4 | 4 | 15.00 | 20 | 8 | Al alloys – additions & joining |
| 5 | 3 | 9.33 | 10 | 9 | Energy generation – nuclear & wind |
| 6 | 10 | 13.70 | 18 | 9 | Energy from coal, and batteries |
| 7 | 6 | 11.67 | 18 | 5 | Mg and Ti alloys |
| 8 | 2 | 8.50 | 14 | 3 | Ferritic alloys, and Sc in Al |
| 9 | 17 | 17.12 | 25 | 11 | Materials used in the body |
| 10 | 13 | 14.92 | 22 | 6 | Hip replacements |
| 11 | 9 | 14.67 | 21 | 5 | Doping of ceramics |
| 12 | 6 | 15.83 | 22 | 4 | Czochralski & gallium arsenide |



## General Comments

A very wide spread in performance for this paper with marks for individual questions ranging from three to 25 (out of 25). A significant number of candidates did very well overall, but the majority performed, on average, less well than expected. Particularly worrying is the very poor understanding of anything to do with metallic materials by some candidates.

## Specific Comments

### ADVANCED POLYMERS

Question 1. Polymer interfacial fracture energy.

Not a particularly popular question on the work of adhesion between two polymers and the determination of the interfacial fracture energy. In part a), not all candidates got the correct equation and several assumed the case where the two materials were the same. Part b) was generally well answered. A significant majority of candidates were not able to do the calculation in part c)i). Some tried to use the $G_{Ic}$ data as part of the calculation, rather than to show the trend. c)ii) was generally well answered, particularly with regard to what the possible mechanisms are.

Question 2. Polymers analysis techniques.

Again, not a particularly popular question, but generally well answered. This question covered the analysis techniques of dynamic mechanical thermal analysis (DMTA), neutron scattering and quasi-elastic neutron scattering (QENS). The section on DMTA was very straightforward and well answered. In the section covering neutron scattering, most candidates managed to answer three out of the four sub-sections reasonably well, with no particular sub-section badly answered. In the section covering QENS, most candidates struggled with one or two of the four sub-sections, but again there wasn’t a particular sub-section which proved particularly difficult.

### ADVANCED MANUFACTURE WITH METALS AND ALLOYS

Question 3. Steels and cast irons.

A very unpopular question. The first part of the question covered the castability of mild steel. Answers generally lacked detail and an appreciation of the effects of shrinkage. The second part of the question covered grey cast irons and the processing required to develop similar properties to those of continuously cast steels. Most answers to this section were of a good standard, and described the mechanisms involved in good detail. The final part of the question dealt with welding techniques for joining thick steel sections. Submerged arc was generally well described, while many candidates did not know what electroslag welding is. Thermit welding was reasonably described, but several candidates did not give sufficient detail in their answers.

Question 4. Al alloys – additions and joining.

Another unpopular question with a wide spread of marks. The question covered additions made to Al alloys shortly before casting and joining methods for Al alloys. Answers to the grain refiner (Al-Ti-B) part of the question lacked detail as to the reasons for making the additions i.e. not just to refine the grains. The modifier addition (Na) was generally answered better, with reasonably good detail as to the mechanisms involved. Answers to the joining part of the question were generally well answered except some candidates were not aware that Al has a tenacious oxide film which makes it difficult to join.

### MATERIALS FOR ENERGY PRODUCTION< DISTRIBUTION AND STORAGE

Question 5. Energy generation – nuclear and wind.

A very unpopular question which was not well answered. The question concerned energy generation by nuclear and by wind. The first part of the question was about load factors for these two types of generation. Load factor was generally incorrectly defined and understood in answers, though it was covered explicitly in lectures and defined in the question! The terms in part b) were generally incorrectly defined in answers and lacked discussion of how reactivity (response with temperature) varies. Part c) was not well answered, as it needed an understanding of reactivity coefficient from part b). Satisfactory answers were given for the need for materials innovation for off-shore wind turbines, but they lacked detail and justification of materials innovation.

Question 6. Energy from coal, and batteries.

A reasonably popular question, though with a wide range of marks. The question covered energy generation in a coal combustion plant and energy storage in various types of batteries. The part of the question asking for a description of a coal combustion plant and the key materials challenges was generally well answered. However, several candidates didn't know what a Rankine cycle is, and this part of the question was generally poorly answered. Knowledge of the principle of operation of a battery and descriptions of the Daniell cell were generally answered well, though some candidates got the reactions round the wrong way and others didn't have separate electrolytes. Knowledge of lithium ion batteries was virtually non-existent.

**ADVANCED ENGINEERING ALLOYS AND COMPOSITES**

Question 7. Mg and Ti alloys.

Not a very popular question on the applications of Mg and Ti alloys, which had some good answers and some very poor answers. The first part of the question on comparing the properties of pure Mg and Ti was generally well done. The second part of the question on suggesting Ti alloys suitable for particular applications and the alloys conventionally used, produced more mixed answers. A lot of candidates incorrectly thought that Cu alloys are used for pipes for chemical processing. There were some good answers for the landing gear for large passenger aircraft, as was also the case for jet turbine blades, though here several candidates incorrectly selected Ti64 as an appropriate alloy.

Question 8. Ferritic alloys, and Sc in Al.

A very unpopular question which was not at all well answered. The suspicion is that some candidates who answered this question had not attended the lecture course and were attempting to answer the question with their knowledge of Engineering Alloys from the General Papers. Unfortunately for them the particular ferritic alloys used in the question were not covered in the General Paper course. The section on the advantages and disadvantages of adding Sc to Al alloys was uniformly very poorly answered.

**BIOMATERIALS AND NATURAL MATERIALS**

Question 9. Materials used in the body.

The most popular question on the paper with a high average mark. The section on tissue expanders was generally well answered although many candidates lost marks for limited discussion of the materials used and the reasoning for this. Many candidates could not remember which polymers are used for replacement blood vessels and marks were also lost for poor discussion of their porous structure. Most candidates could identify the materials used for bone cements, but were weaker on how they were used. A variety of applications were discussed for pLGA, but answers were weak as to how the material was tailored for each application.

Question 10. Hip replacements.

Another very popular question on total hip replacements, with some rather weak answers. In the section concerning the joint reaction force, many candidates could not describe the moments acting around the joint. Most candidates could list three ways to reduce the joint reaction force, but in some cases the description and/or justification was poor. The section describing the advantages and disadvantages of three different metallic alloys was the weakest section of the question, with some candidates confusing modulus and strength. In the final section on the design of the implant, most candidates did consider several aspects but most also left out some of the important aspects.

**DEVICES, MEMORY AND STORAGE**

Question 11. Doping of ceramics.

Generally a reasonably well answered question with well-structured answers, clearly laid out. The section on effective valency was generally well answered. The section on $BaTiO_3$ received more mixed answers, with the doping with Ba ions not very well answered, and the La-doped section lacking details of what is happening in the vicinity of the grain boundaries. The final section on the use of $SnO_2$ for gas sensors was generally well answered.

Question 12. Czochralski and gallium arsenide.

Not a particularly popular question, but there were some good answers. The section on Czochralski growth of gallium arsenide was generally well described with most of the key points included. In the second section on the manufacture of laser diodes from a semi-insulating gallium arsenide ingot, some of the candidates described processes not appropriate to the product.

# Examiners' Report for MEM 2013 – Economics Papers

**Part II**

Four papers were available to Part II candidates: Macroeconomics, Econometrics, Microeconomic Theory and Game Theory. No MEM candidates offered an economics option paper.

Alan Beggs

# Examination Conventions 2012/13
# Final Honours School
# Materials, Economics and Management

## 1. INTRODUCTION

The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. These conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The examiners are nominated by the Nominating Committee* in the Department of Materials and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. Formally, examiners are independent of the Department and of those who lecture courses. However for written papers on Materials Science in Part I and Part II, examiners are expected to consult with course lecturers in the process of setting questions. The paragraphs below indicate the conventions to which the examiners usually adhere, subject to the guidance of the appointed external examiners, and other bodies such as the Academic Committee in the Department, the E(M)EM Standing Committee, the Mathematical, Physical and Life Sciences Division, the Social Sciences Division, the Education Committee of the University and the Proctors who may offer advice or make recommendations to examiners. It must be stressed that to preserve the independence of the examiners, candidates are not allowed to make contact directly about matters relating to the content or marking of papers. Any communication must be via the Senior Tutor of your college, who will, if he or she deems the matter of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Examiners.

Marking criteria for the Team Design Project are published in the FHS course handbook.

During the marking process the scripts of all written papers remain anonymous to the markers.
[In some of the descriptions of marking for individual elements of coursework that are given later in this document the term 'double marked, blind,' is used; this refers to the fact that the second marker does not see the marks awarded by the first marker until he or she has recorded his or her own assessment, and does not indicate that the candidate is anonymous to the markers.]

**Late Submission of or Failure to Submit Coursework**
The Examination Regulations stipulate specific dates for submission of the required pieces of coursework to the Examiners (1. A set of detailed reports of practical work; 2. A Team Design Project Report; 3. Industrial Visit Reports as specified in the course handbook; and 4. A Part II Management Project Report). Rules governing late submission and any consequent penalties are set out in the 'Late submission of work' sub-section of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations (pp45-46 of the 2012 Regulations).

Under the provisions permitted by the regulation, late submission of coursework for Materials Science or Materials, Economics & Management examinations will normally result in the following penalties:

(d) With permission from the Proctors under clause (1) of para 16.8, no penalty.

(e) With permission from the Proctors under clauses (3) + (4) of para 16.8, for the first day or part of the first day that the work is late a penalty of a reduction in the mark for the coursework in question of up to 10% of the maximum mark available for the piece of work, and for each subsequent day or part of a day that the work is late a further penalty of up to 5% of the maximum mark available for the piece of work; the exact penalty to be set by the Examiners with due consideration given to any advice given in the Proctors' "Notes for the Guidance of Examiners and Chairmen of Examiners".

(f) Where the candidate is not permitted by the Proctors to remain in the examination he or she will be deemed to have failed the examination as a whole.

Where no work is submitted or it is proffered so late that it would be impractical to accept it for assessment the Proctors may, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chairman of the Examiners, permit the candidate to remain in the examination. In this case the Examiners will award a mark of zero for the piece of coursework in question.

* for the 2012-13 examinations the Nominating Committee comprised Prof Grovenor & Dr Taylor.

Penalties for late submission of individual practical reports are set out in the MS/MEM FHS Handbook and are separate to the provisions described above.

## 2. PARTS I & II

**Candidates taking Ec1: Introductory Economics in the 2nd year.**
MEM candidates sit the compulsory Ec1: Introductory Economics paper in Trinity Term of their second year. This paper will be set and examined as for all other Part I and Part II Economics papers (see below) and contributes to the Part I mark. The marks for this paper will be formally ratified by the Board of examiners for Part I examinations held in the Trinity Term following that in which the Ec1 paper is sat.

**Candidates for Part I (3rd year)**
Part I candidates take four compulsory Materials papers (General Papers 1 – 4); one compulsory Economics paper; and one compulsory Management paper. In addition, candidates are assessed on their Materials coursework (practical work, the team design project, and industrial visits). Marks from the Ec1 paper sat in Trinity Term of the 2nd year are included in the Part I total.

**Candidates for Part II (4th year)**
Part II candidates take one compulsory Materials Options paper and one paper from a range of Management and Economics options. In addition they are assessed on their report of a six-month industrial placement, which carries the weight of two papers.

(1) *Setting of papers*

Part I Materials General Papers 1 – 4 are set by the materials examiners in consultation with course lecturers. The responsibility for the setting of each examination paper is assigned to an examiner, and a second examiner is assigned as a checker. The Materials Option paper in Part II is set by lecturers of option courses and two examiners, the examiners acting as checkers. For the Materials papers, the examiners, in consultation with lecturers, produce model answers for every question set and the wording and content of all examination questions set, and the model answers, are scrutinised by all examiners, including, in particular, the external examiners.
The Economics and Management papers are set by examiners nominated respectively by the Economics Faculty and the Saïd Business School.

(2) *Paper format*

**Materials Papers**
All Materials general papers comprise eight questions from which candidates attempt five and are taken in Part I. Each question is worth 20 marks. The total number of marks available on each general paper is 100. Materials Option papers comprise one section for each twelve-hour Options lecture course, each section containing two questions: candidates are required to answer one question from each of any three sections and a fourth question drawn from any one of the same three sections. The total number of marks available on each option paper is 100, and all questions carry equal marks. Questions are often divided into parts, with the marks for each part indicated on the question paper.

**Economics and Management papers**
Candidates are advised to read particularly carefully the specific instructions on the front of each paper as to the number of questions they should submit, since the rubrics on Economics and Management papers differ slightly from those for the Materials papers.

(3) *Marking of papers*

**Materials Papers**
All scripts are double marked, blind, by the setter and the checker. After individual marking the two examiners meet to agree marks question by question. If the differences in marks are small (~10%, 2-3 marks for most questions), the two marks are averaged, with no rounding applied. Otherwise the examiners identify the discrepancy and read the answer again, either in whole or in part, to reconcile the differences. If after this process the examiners still cannot agree, they seek the help of the Chairman, or another examiner as appropriate, to adjudicate. An integer total mark for each paper is awarded, where necessary rounding up to achieve this.

The Materials Options paper is marked by course lecturers acting as assessors and an examiner acting as a checker.

The Materials external examiner provides an independent check on the whole process of setting and marking.

The rubric on each paper indicates a prescribed number of answers required (e.g. "candidates are required to submit answers to no more than five questions"). Candidates will be asked to indicate on their cover sheet which questions, up to the prescribed number, they are submitting for marking. If the cover slip is not completed then the examiners will mark the first five questions in numerical order by question number. The examiners will NOT mark questions in excess of the prescribed number. If fewer questions than the prescribed number are attempted, (i) each missing attempt will be assigned a mark of zero, (ii) for those questions that are attempted **no** marks beyond the maximum per question indicated under section 2(2) above will be awarded and (iii) the mark for the paper will still be calculated out of 100.

As the total number of students sitting some papers is small, it is not unusual for mean marks to vary from paper to paper, or year to year. It is not therefore normal practice to adjust marks to fit any particular distribution. However, where marks for papers are unusually high or low, the examiners may, having reviewed the difficulty of the paper set or other circumstances, decide with the agreement of the external examiners to adjust all marks for those papers. For the Materials papers such adjustment is referred to as 'scaling' and the normal procedure will be as follows:

a. Papers with a *mean taken over all candidates* of less than 55% or more than 75% are normally adjusted to bring the *mean* respectively up to 55% or down to 75%. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate's score for the paper.
b. For papers with a mean in the ranges either of 55-60% or 70-75%, including those scaled under (i) above, the questions and typical answers are compared in order to ascertain, with the help of the external examiners, whether the marks are a fair reflection of the performance of the candidates as measured against the class descriptors. If not, the marks are adjusted. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate's score for the question or for the paper.
c. The mean mark and the distribution of marks, both taken over all written papers, are considered, again with the help of the external examiners, in order to ascertain whether these overall marks are a fair reflection of the performance of the candidates as measured against the class descriptors. If not, the overall marks are adjusted. Normally this is achieved by adding/subtracting the same fixed number of marks to/from each candidate's overall score.

**Economics and Management Papers**
The rubrics on Management and Economics papers differ slightly from the above, but numerical marking is used and all examiners mark to the standard class boundaries [see section on classification] and range of marks (0-100). All scripts in Economics and Management are double-marked, blind. The two assessors who marked the script then meet in order to reach an agreed mark. Should they fail to agree, then the appropriate set of Economics and Management Examiners will determine the final mark.

In cases of short weight, the maximum achievable mark is lowered by the proportion of the paper missing. (For example, in a paper requiring four answers where a candidate has attempted only three, the maximum achievable mark is 75.) In cases where an answer has been partially completed, the marks will use their discretion to decide what proportion of the answer is missing. Marks reflecting such a penalty are flagged "SW" with the proportion of the paper completed (e.g. "SW 75%). In the case of overweight papers it is left to the discretion of the two markers to decide which of the material to disregard. In cases where the rubric requires candidates to show a specified breadth of knowledge, and where it is unambiguously clear that such a requirement has not been met, the mark for the script will be lowered by at least 5 points. Marks reflecting such a penalty are flagged by "RR" with the number of marks deducted.

As the total number of MEM students is small, it is not unusual for mean marks to vary from paper to paper, or year to year. It is not therefore normal practice to adjust marks to fit any particular distribution. However, where marks for papers are unusually high or low, the examiners may, having reviewed the difficulty of the paper set or other circumstances, decide with the agreement of the external examiners to adjust all marks for those papers. Where a paper has been taken by both MEM and EEM students normally the decision will be informed by the mean and the distribution of marks taken over all EEM & MEM candidates for that paper.

Such adjustment is referred to as ‘scaling’ and in deciding what scaling, if any, to apply normally the examiners will take into account the following additional information:

(a) For each paper, comments from the MEM examiners representing the Economics or Management Faculty as appropriate

(b) A report by the Chairman of Examiners on any scaling adopted by the EEM examiners

(c) The performance of the MEM cohort and the MEM+EEM cohort on the other Economics and Management papers

(d) The performance of the MEM cohort on the Materials papers

(4) *Marking of Practicals for Part I*

Practicals are assessed continually by senior demonstrators in the teaching laboratory and in total are allocated 50 marks. Part I examiners have the authority to set a practical examination.

(5) *Marking Industrial Visits*

Four industrial visit reports should be submitted during Part I. Reports are assessed by the Industrial Visits Academic Organiser on a satisfactory / non-satisfactory basis, and are allocated a total of 20 marks.

(6) *Marking the Team Design Projects*

The team design project is double marked, blind, by two of the Part I Examiners. They then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each project and each team member. Supervisors of the projects submit a written report to the examiners on the work carried out by their teams and these are taken into consideration when the examiners decide the final agreed marks. Industrial representatives may be asked to contribute to the assessment process. The project is allocated 50 marks, of which 25 are for the written report and 25 for the oral presentation. The same two examiners assess both the reports and the presentations.

(7) *Marking the 4$^{th}$ Year Management Project*

The management project is allocated 200 marks and is marked by the Saïd Business School.

The projects are assessed and graded independently by two Assessors. The supervisor’s comments on the performance of the candidate are provided to the Assessors. The marks provided by the Assessors are moderated by an Examiner, and the final mark is ratified by the Board of Examiners.

The process is:

- Supervisors provide a report on the performance of the student, indicating any special circumstances that could have affected the student’s performance on the project and report preparation.
- The project reports are graded blind by two Assessors, taking account of the Supervisor’s comments. At least one of the Assessors will have knowledge of the area of the project.
- The Supervisor’s report, and Assessors’ reports and marks are provided to an Examiner, who moderates the marks and provides a final mark for ratification by the Board of Examiners.
- Supervisors may not act as Assessor or Examiner for a project they have supervised.
- An Assessor may also act as Examiner for a project. The Assessor should assess and mark the report before having sight of the other Assessor’s report and marks.

**External Examiners**

**Materials:**

Professor W.M. Rainforth
Department of Materials Science and Engineering
University of Sheffield

Professor M.G. Burke
The School of Materials,
University of Manchester

**Management:**

Professor S.M. Wood
The Surrey Business School
University of Surrey

**Economics:**

Dr H.D. Simpson
Department of Economics
University of Bristol

## 3. CLASSIFICATION

The following boundaries (CVCP) and descriptors (MPLSD) are used as guidelines:

| | |
|---|---|
| Class I Honours 70 – 100 | The candidate shows excellent problem-solving skills and excellent knowledge of the material over a wide range of topics, and is able to use that knowledge innovatively and/or in unfamiliar contexts. |
| Class IIi Honours 60 – 69 | The candidate shows good or very good problem-solving skills, and good or very good knowledge of much of the material over a wide range of topics. |
| Class IIii Honours 50 – 59 | The candidate shows basic problem-solving skills and adequate knowledge of most of the material. |
| Class III Honours 40 - 49 | The candidate shows reasonable understanding of at least part of the basic material and some problem solving skills. Although there may be a few good answers, the majority of answers will contain errors in calculations and/or show incomplete understanding of the topics. |
| Pass 30 - 39 | The candidate shows some limited grasp of basic material over a restricted range of topics, but with large gaps in understanding. There need not be any good quality answers, but there will be indications of some competence. |
| Fail 0 - 29 | The candidate shows inadequate grasp of the basic material. The work is likely to show major misunderstanding and confusion, and/or inaccurate calculations; the answers to most of the questions attempted are likely to be fragmentary only. |

In borderline cases the examiners use their discretion and consider the overall quality of the work the candidate has presented for examination.  The external examiner often plays a key role in such cases.

**Part I:**

*Unclassified Honours* – The examiners are required to classify each candidate according to her/his overall average mark in Part I as (a) worthy of Honours, (b) Pass or (c) Fail. A candidate is allowed to proceed to Part II only if he/she has been adjudged worthy of honours by the examiners in Part I. The examiners do not divide the categories further but tutors and students may infer how well they have done from their marks. Candidates adjudged worthy of honours normally proceed to Part II but they may, if they wish and subject to approval from the relevant bodies, leave after Part I in which case an Unclassified Honours B.A. degree will be awarded.

*Pass* – The examiners consider that the candidate is not worthy of honours and therefore will not be allowed to proceed to Part II. The candidate may leave with a B.A. (without honours) or may retake Part I the following year (subject to college approval).

*Fail* – The examiners consider that the candidate is not worthy of a B.A. The candidate either leaves without a degree or may retake Part I the following year (subject to college approval).

**Part II:**

*Classified Honours* – Once marking is completed for both Parts I and II an overall percentage mark is computed for each candidate and classification then takes place. Subject to the requirement that Part II be adjudged worthy of honours (see below), classification is based solely on the overall percentage mark; the candidate's profile of marks from each element of assessment is only taken into account in borderline cases. However, a candidate cannot be awarded an M.Eng. degree unless his/her performance in Part II is adjudged worthy of honours i.e. a candidate must be adjudged worthy of honours both in Part I and in Part II to be awarded the M.Eng. degree. Failure to achieve honours in Part II will result in the candidate leaving with an unclassified B.A. (Hons) irrespective of the aggregate mark.

*Pass* – Notwithstanding the award of unclassified honours in Part I, the examiners consider that the candidate's overall performance is not worthy of an M.Eng. The candidate is listed as a Pass on the class list and is awarded an unclassified B.A. (Hons) on the basis of Part I performance.

*Fail* – The examiners consider that the candidate's overall performance is not worthy of an M.Eng. *and* that the performance in Part II is not worthy of a Pass. The candidate is excluded from the class list but is nevertheless awarded an unclassified B.A. (Hons) on the basis of Part I performance.

- The examiners cannot award unclassified honours on the basis of Part II performance unless permitted to do so by the Proctors.
- Nevertheless, candidates awarded a Pass or a Fail by the Part II examiners leave with an unclassified B.A. (Hons) because they were judged worthy of that in Part I (i.e. their degree is the same as if they had left immediately after Part I).
- In terms of the degree awarded, there is no difference between a Pass and a Fail in Part II. The only difference is whether or not the name appears on the class list.
- Candidates cannot normally retake Part II because the Examination Regulations require that they must pass Part II within one year of passing Part I. This rule can only be waived in exceptional circumstances, with permission from the Education Committee.

**Annex: Summary of marks awarded for different components of the MEM Final Examination in 2013 (For Part I and Part II students who embarked on the FHS respectively in 2011/12 and 2010/11)**

| | **Component** | **Mark** |
|---|---|---|
| **Part I** | General Paper 1 | 100 |
| | General Paper 2 | 100 |
| | General Paper 3 | 100 |
| | General Paper 4 | 100 |
| | Introductory Economics (Ec1) | 100 |
| | General Management | 100 |
| | Microeconomics | 100 |
| | Practicals & Industrial visits | 70 |
| | Team Design Project | 50 |
| *Part I Total* | | *820* |
| **Part II** | Management Project | 200 |
| | Materials Options Paper 2 | 100 |
| | One paper from a choice of Economics and Management Papers. | 100 |
| *Part II Total* | | *400* |
| *Overall Total* | | *1220* |

# MATERIALS EXTERNAL EXAMINERS' REPORTS

MANCHESTER
1824

The University of Manchester

Materials Performance Centre
School of Materials
Faculty of Engineering and Physical Sciences
The University of Manchester
Sackville Street
Manchester M13 9PL

+44(0)161 306 4838
www.manchester.ac.uk

9 July 2013

Dear Vice-Chancellor (c/o Mrs. Sally Powell),

**External Examiner's Report: Honour School of Materials Science and Honour School of Materials, Economics, and Management, Academic Year 2012/13**

As a member of the external examining committee, I am pleased to report that the standards of assessment and student performance in these Honour Schools are excellent. All procedures and processes reflect the highest standards of performance. Some minor comments are discussed below under the specific topics:

**(i) Whether the academic standards set for its awards, or part thereof, are appropriate;**

Based on the assessments of the coursework, examinations and the Part II theses, I have concluded that the rigorous academic standards of the Department of Materials are indeed appropriate. The breadth and depth of the examination questions successfully enabled the identification of clear differentiation amongst the student performance: First Class student performance was characterised by outstanding knowledge and understanding as evidenced by examination results and Part II thesis research. Indeed, it was unexpected to find such impressive quality in research at the undergraduate level. The students within the Second Class range also demonstrated very high degrees of knowledge and understanding of the subject matter.

**(ii) The extent to which its assessment processes are rigorous, ensure equity of treatment for students and have been fairly conducted within institutional regulations and guidance;**

I am satisfied that the assessment processes are rigorous and fully reflect the high standards that are expected at the University. All written examinations have been marked "blindly" by two examiners with no knowledge of the student's identity. In reviewing numerous examination papers for all four General Papers and selected Optiional Papers, I noted that the examiners marked the answers fairly and thoughtfully. Appropriate attention and consideration has been taken particulary with respect to any additional considerations such as health and disabilities. I also noted that the marking process for the Part II research projects were very thorough, with two Internal Examiners and one External Examiner. All members of the examination committee were permitted to question each student during the viva. The assessment processes were suitable to differentiate student performance (First Class, Upper and Lower Second Class Honours).

**(iii) The standards of student performance in the programmes or parts of programmes which they have been appointed to examine (those examining in joint schools are particularly asked to comment on their subject in relation to the whole award):**

The student performance standard is very high, and is a credit to the University. The range of technical achievement evidenced via the Part II vivas ranged from good to outstanding. The calibre of the research varied somewhat, as to be expected, but all individual student performances during the viva varied from good to superb, which reflects the high calibre of student. It is clear that the students with First Class Honours will be a tribute to the Department and the University throughout their future careers.

**(iv) Where appropriate, the comparability of the standards and student achievements with those in some other higher education institutions:**

The rigorous admissions process at the University ensures that the students are the very best, so it is not surprising that the student achievement and standards are higher than most Universities. Furthermore, the Department of Materials is one of the premier Materials Science Departments internationally. Although the specific degree programmes can differ in technical content amongst Materials Science Departments throughout the UK (and internationally), it is abundantly clear that that the standards and student achievement are extremely rigorous, and are a credit to the University.

**(v) Issues which should be brought to the attention of supervising committees in the faculty/department, division or wider University:**

I was extremely impressed with the depth and breadth of the examinations and coursework that I had the opportunity to review. All coursework and project reports reflected very high standards. The third year reports and the Part II theses were impressive and very well-written.

The Practical Books contained a wide range of reports based on various laboratory exercises and experiments, as opposed to a laboratory notebook to record experimental procedures, observations and data. As these Practical Books reflected a very high standard of work (handwritten reports), perhaps the department might consider whether the use of a laboratory notebook for recording the experimental procedures, data/measurements acquired, observations and data analysis would be worthwhile, since it would also serve as an introduction to the type of record-keeping that will be required for the independent research in Part II. It could then be possible for the students to prepare a more thorough laboratory report to be submitted for evaluation (perhaps a report from each of two practicals selected by the student). Thus, the students would still retain the benefit of a laboratory book for the proper documentation of data/results from the experiments, while also providing a formal report (which need not be handwritten).

**(vi) Good practice that should be noted and disseminated more widely as appropriate:**

I was very impressed with the Part II assessment process, with two Internal Examiners and one External Examiner for the detailed evaluation and the open viva with the entire committee. This provided the opportunity for further clarification and assessment of the student's depth of knowledge. I found this process to be extremely fair and most commendable, for it enabled questioning from all committee members.

I congratulate the Department of Materials on their very successful programme, rigorous internal assessments, and high standards of student achievement.

M G Burke

Prof. M.Grace Burke, PhD, DIC, FASM, FRMS, FMSA
Director – Materials Performance Centre
Director – Electron Microscopy Centre

The University Of Sheffield.

Department Of Materials Science & Engineering.

**Head of Department:** Professor W M Rainforth

Sir Robert Hadfield Building
Mappin Street
Sheffield S1 3JD
United Kingdom

**Telephone:** +44 (0) 114 222 5466
**Fax:** +44 (0) 114 222 5943
**Website:** www.shef.ac.uk/materials

4th July 2013

Dear Vice Chancellor

**External Examiners Report: Honour School of Materials Science and Honour School of Materials, Economics, and Management, Academic Year 2012/13**

In summary, I found the examination procedures, standards and conventions to be all highly satisfactory. The overall standards were excellent. There are some minor comments, addressed below under the specific topics:

**(i) Whether the academic standards set for its awards, or part thereof, are appropriate**

The academic standard set is challenging, but appropriate. The standard within the written examination papers was generally very high, with only exceptional answers receiving high marks. The standard of the Part II theses that I saw (half of the cohort) was largely excellent.

**(ii) The extent to which its assessment processes are rigorous, ensure equity of treatment for students and been fairly conducted within institutional regulations and guidance**

All examinations were marked blind by two independent markers, which ensured absolute equity of treatment for all students. Where marks awarded by the two examiners differed significantly (which was uncommon) appropriate procedures were in place for the moderation.

The process for ensuring equitable assessment of Part II theses is rigorous. This is difficult given the wide range of topics from theoretical to experimental research. However, the combination of two internal markers, the external examiner, the viva and the careful reporting of project management ensures that the assessment is rigorous.

Overall, the examination process is rigorous and transparent and should be thoroughly commended.

**(iii) The standards of student performance in the programmes or parts of programmes which they have been appointed to examine**

In general, the student performance was excellent. The top students, who were awarded the highest level of degree, were without doubt outstanding and will undoubtedly be a tribute to Oxford University.

Marking carefully discriminated the difference between standard, good and exceptional students. In the latter case, the student needed to show substantial, in-depth, knowledge of the subject. Attaining a first class degree certainly required an excellent level of achievement.

The Part II theses that I saw this year were good to exceptional. As in previous years, the top theses were simply excellent, and I would judge to be of the standard of an MPhil degree. The report on project management by supervisor and student is a great help in defining the standard and understanding the problems that the student encountered. The Part II viva also gives substantial insight into the student's performance. Thus, I believe the current procedures in place are excellent, and the student's achievement is thoroughly assessed in a fair and equitable manner.

**(iv) Where appropriate, the comparability of the standards and student achievements with those in some other higher education institutions**

In general, the level of attainment by the students is in-line with that expected of Oxford University, namely at a higher level that many other higher education institutions. It is difficult to make an absolute comparison as most other Material Science and Engineering degree courses have quite a different structure, specifically they do not include a Part II thesis which involves a full academic year. In any event, I am confident that the student achievement of Materials students at Oxford University is outstanding. Moreover, the depth and breadth of knowledge of the students, resulting from a wide range of challenges set, is without question, excellent.

**(v) Issues which should be brought to the attention of supervising committees in the faculty/department, division or wider University**

There is one minor issue that the Department may wish to consider. The laboratory books contain only the laboratory write up and I can see no evidence of the lab books being used to record data and experimental observations, which is basic good practice.

**(vi) Good practice that should be noted and disseminated more widely as appropriate**

As noted last year, I remain impressed by several aspects of the student experience and examination process. The scope and depth of the part II project is excellent, as is the manner in which students are trained on research equipment for their part II projects. The examination committee, that blind marks examination papers and Part II projects, is an example of excellent practice in ensuring high standards and equitable treatment of all examiners. At the end of the course, the students have received both depth in understanding of the subject and also breadth of experience.

In summary, I would like to congratulate the department on the high standards that they have maintained.

Professor WM Rainforth

## Faculty of Materials
## Department of Materials Academic Committee

# RESPONSE TO EXAMINERS' REPORTS 2013

**Honour School of Materials Science (MS) Parts I & II**

**Honour School of Materials, Economics & Management (MEM) Parts I & II – Materials elements only, main response will be made by the E(M)EM Standing Committee**

The External Examiners' reports, the FHS Chairperson's report and internal reports on all of the individual Materials papers were considered by the Department of Materials Academic Committee (DMAC) and were reported to the Faculty of Materials.

### 1. Summary of major points

There were no major issues arising from the 2013 Examinations.

### 2. Points for inclusion in Responses to the External Examiners

**MS & MEM Parts I & II: Professor MG Burke**

We thank Professor Burke for her positive report and the time and effort devoted to her role as an External Examiner, not least in reading the Part II MS theses.

Professor Burke commented that the Laboratory Notebooks seen by the Examiners contain finalised lab reports but not the lab observations/notes/analyses made during the practical classes. This timely comment was taken into account in the full review of our practical classes provision that took place during the Long Vacation 2013 with the result that with immediate effect for the current 1st & 2nd year students their lab observations/notes/analyses will be captured in the Laboratory Notebooks that are submitted to the Examiners and therefore will be seen first for the Part I Examination in 2015.

The External Examiners and Chair of FHS Examiners informally commented on the substantial workload associated with their scrutiny of the MS Part II theses. While noting that a greater than usual proportion of students following the MEM programme and a blip in student recruitment will mitigate this problem respectively in the 2014 and 2015 Part II Examinations, in 2014 the Department will be considering what approach to take beyond 2015.

**MS & MEM Parts I & II: Professor W.M. Rainforth**

We thank Professor Rainforth for his positive report and the time and effort devoted to his role as an External Examiner, not least in reading the Part II MS theses. We would also like to thank him very much for his constructive and thoughtful input over the whole four years of his appointment as one of our external examiners.

Professor Rainforth commented that the Laboratory Notebooks seen by the Examiners contain finalised lab reports but not the lab observations/notes/analyses made during the practical classes. This timely comment was taken into account in the full review of our practical classes provision that took place during the Long Vacation 2013 with the result that with immediate effect for the current 1st & 2nd year students their lab observations/notes/analyses will be captured in the Laboratory Notebooks that are submitted to the Examiners and therefore will be seen first for the Part I Examination in 2015.

The External Examiners and Chair of FHS Examiners informally commented on the substantial workload associated with their scrutiny of the MS Part II theses. While noting that a greater than usual proportion of students following the MEM programme and a blip in student recruitment will mitigate this problem respectively in the 2014 and 2015 Part II Examinations, in 2014 the Department will be considering what approach to take beyond 2015.

**MEM Parts I & II, Management Papers: Professor S.M. Wood**

We thank Professor Wood for his positive report and for his careful scrutiny of scripts and we concur with his comments on the value of outline answers.

**MEM Parts I & II, Economics Papers: Dr H Simpson**

We thank Dr Simpson for her positive report and for her careful scrutiny of scripts and we concur with her comments on the value of outline answers.

We note that her comment regarding the economics content of the programme is more relevant to the EEM programme since for our MEM programme there are **two** compulsory core economics papers (years 2 & 3) then in year 4 a choice between either an economics paper or a management paper.

## 3. Further Points

(a) We have no major comments to make on trends in FHS statistics. Noting the importance of considering averages over five or six years when dealing with small cohorts of students we observe that the proportions of first class and upper second class degrees awarded do not differ greatly from the MPLSD averages. In Materials there continues to be no significant gender gap in the proportions of male and female candidates who gain first class degrees.

(b) Considered over several years, performance in Paper GP3 is weaker than it should ideally be, yet repeatedly the Boards of Examiners scrutinise this paper and report that the questions and the material they cover are entirely appropriate. The Department's Teaching Committee has resolved to introduce changes in the teaching of this paper in an effort to improve the average performance.

## 4. Examination Conventions

We confirm that when updating our Examination Conventions we consider the points in the EdC notes of guidance on Examinations & Assessment, para 3.12, as reproduced in the May 2013 letter from the MPLSD headed 'External examiners' reports 2013'. DMAC and the incoming Board of Examiners will jointly approve the updated conventions. In so doing consideration will be given to the recent guidance from the MPLS Division on Penalties for late submission of coursework.

A.O. Taylor, Chairman of DMAC, 26/11/13

# E(M)EM Standing Committee

## Reports from the External Examiners for the Economics & Management Components of MEM Part I & II

Department of Economics
University of Bristol
8 Woodland Road
Bristol, BS8 1TN

The Vice-Chancellor
c/o Mrs Sally Powell
Assistant Registrar
Education Policy Support
University Offices
Wellington Square
Oxford, OX1 2JD

16th July 2013

**EXTERNAL EXAMINER REPORT (ECONOMICS) FOR THE DEGREES IN: ECONOMICS AND MANAGEMENT (8TH JULY); ENGINEERING, ECONOMICS AND MANAGEMENT (28TH JUNE); AND MATERIALS, ECONOMICS AND MANAGEMENT (28TH JUNE)**

**OVERALL COMMENTS**

The examinations process was extremely well administered, and I would like to highlight in particular the excellent management of the process for Economics by Dr Christopher Bowdler and Katherine Cumming. In addition, all three exam board meetings were run very efficiently and professionally.

**I) ACADEMIC STANDARDS**

For all three degrees the academic standards set were entirely appropriate, as were the degree classification thresholds.

**II) ASSESSMENT PROCESSES**

The assessment processes were both rigorous and fair. The examination papers for Economics were very well set, providing students with an opportunity to demonstrate their understanding, yet also stretching the candidates and therefore allowing the examinations process to clearly distinguish between performances at different points in the distribution.

The process of double-blind marking, followed by marks being agreed by the two markers ensures that exam performance is fairly assessed.

**III) STUDENT PERFORMANCE**

I assessed economics scripts from range of points in the marks distribution. Overall the achievement of students on these degree programmes is very high, demonstrating the students' ability, the depth of their understanding and also the strength of teaching.

For the degrees of Engineering, Economics and Management (EEM) and Materials, Economics and Management (MEM), taking into account the fact that more technical papers can produce quite different distributions of marks compared to discursive or essay-based exam papers, there was no evidence that students were either systematically under or over-performing on the Economics component of the course compared to the other disciplines. One point that I would just like to note with regard to the EEM and MEM degrees is that in a few cases students did not seem to have taken any Economics papers in their final year (for example, taking papers in Finance or Accounting instead), hence the extent to which performance in Economics papers contributed to the overall final average mark could be very low.

**IV) COMPARABILITY WITH OTHER HIGHER EDUCATION INSTITUTIONS**

I found the standards set in the Economics exam papers to be comparable to, or above, the standards set at my university (Bristol). The technical papers in econometrics, economic theory and game theory set a high standard and were comparable to those set at Bristol where the undergraduate Economics and Economics and Econometrics degrees contain a strong mathematical and econometrics component.

I would also like to note that the range of option choices available to students was extremely impressive.

**V) OTHER ISSUES**

I had one comment on the provision of solutions for exam papers. In general excellent solutions were provided for the technical Economics papers, however in many cases no outline answers were provided at all for the essay-based and discursive exam questions (although there were some exceptions to this). It might be helpful, especially if papers are not always marked by the lecturer who taught the course, to provide at least some guidance to markers of essay-based questions as to the main points that an essay might cover, and what a first class essay might contain. Providing answers would further improve consistency in marking if papers are being marked by a number of individuals. Providing sketch answers can also help the question setter come up with better questions and ensure that the different questions within a paper are similarly challenging.

**VI) GOOD PRACTICE FOR FURTHER DISSEMINATION**

Economics papers containing multi-part questions very clearly indicated the fraction of marks available for each part, which is extremely helpful for both students sitting the exams and markers, with regard to ensuring consistency in marking. This was well implemented across all papers.

The provision of information and guidance for the External Examiners when assessing scripts prior to the Exam Board meetings was extremely helpful. In particular, it was very helpful for the External Examiners to be able to see each internal assessor's marks for individual exam questions; this made it much easier to see how the final grade was arrived at.

**Dr Helen Simpson**
**Reader in Economics, University of Bristol**

UNIVERSITY OF SURREY

**Surrey Business School**
Guildford, Surrey GU2 7XH UK

**Professor Steve Wood** PhD

Professor of Retail Marketing and Management

T: +44 (0)1483 683113
E: sm.wood@surrey.ac.uk

www.surrey.ac.uk/sbs

10th July 2013

Mrs Sally J. Powell
Assistant Registrar
Education Policy Support
University of Oxford
University Offices,
Wellington Square,
Oxford OX1 2JD

Dear Mrs Powell,

<u>External Examiner's Report: Management</u>

This is my second year acting as external examiner for Management programmes within Management and Economics, but also across the Engineering and Materials programmes. Consistent with last year, I have attended three examination boards and was provided with adequate access to examination scripts across the spectrum of student performance:

1. Materials, Economics and Management Exam Board (28th June 2013)

2. Engineering, Economics and Management Exam Board (28th June 2013)

3. Economics and Management Exam Board (8th July 2013)

I structure my report in accordance with the suggested headings after making some general observations:

The standard of the students' work that I reviewed was generally of a very high quality, demonstrated knowledge of theory and practice, but also exhibited an ability to critically analyse to a sophisticated level. Assessment was appropriately targeted and stretching for students.

Marking was anonymous and "double blind". Markers discussed an "agreed mark" where their initial marks were some way apart. Such practice ensured that assessment was robust and considered. Given the high calibre of the students, it was not surprising that there was a preponderance of First and Upper Second Class marks. Indeed, I believe the marking to be consistent, fair and appropriate. In examination boards, individual students were given close consideration by university staff and external examiners, especially in circumstances where they sat on grade borderlines.

Accredited by Association of MBAs

AACSB ACCREDITED

THE QUEEN'S ANNIVERSARY PRIZES FOR HIGHER AND FURTHER EDUCATION 2011

**(i) Whether the academic standards set for its awards, or part thereof, are appropriate.**

The assessment was challenging and provided the basis for students to demonstrate performance across the entire marking range. The assessment offered an appropriate balance between academic theory, critical analysis and the application to management practice.

**(ii) The extent to which its assessment processes are rigorous, ensure equity of treatment for students and have been fairly conducted within institutional regulations and guidance.**

Marking was anonymous and "double blind". Markers discussed an "agreed mark" where their initial marks were some way apart. Such practice ensured that assessment was robust and considered. In the examination boards, individual students were given close consideration by university staff and external examiners, especially in circumstances where they sat on grade borderlines. External examiners were provided with all of the resources necessary to understand student performance and assessment.

**(iii) The standards of student performance in the programmes or parts of programmes which they have been appointed to examine (those examining in joint schools are particularly asked to comment on their subject in relation to the whole award).**

Student performance was typically categorised as either First Class or Upper Second Class. This reflected the ability and genuine attainment of the cohorts that I looked at. There was only a very small tail of lower performance.

Engineering and Materials students had the opportunity to take management subjects – something that should benefit their future careers. Student performance from these cohorts was impressive. In particular, this attainment was evident in the varied and interesting applied dissertations that were written when students were placed within "blue chip" businesses.

**(iv) Where appropriate, the comparability of the standards and student achievements with those in some other higher education institutions.**

The very top end of student performance was of truly exceptional ability. These achievements were all the more notable given the intensive exam-based Finals nature of assessment. In general though, the performance of students was similar in quality to the top-end of ability range that I have seen at universities elsewhere – the main difference at Oxford appears to be a much shorter "tail" of less accomplished performance.

**(v) Issues which should be brought to the attention of supervising committees in the faculty/department, division or wider University.**

Consistent with last year, Faculty should be congratulated on contributing to some fine student performance in the final examinations. The process for the setting of examinations and the subsequent assessment is tight, fair and consistent.

There is one possible slight change to preparing assessment that I suggest warrants some consideration: When preparing exam assessment in future, I would encourage colleagues to consider writing short indicative answers (a few sentences), making clear the desired content of accomplished responses. This practice is widespread across UK universities. Of course, I understand concerns about avoiding being too prescriptive and that doing so does not limit the content that "good" essay answers may offer, but my understanding is that it assists the marking process – particularly aiding second markers and external examiners – but also, arguably, benefits the process of designing exam papers.

**(vi) Good practice that should be noted and disseminated more widely as appropriate.**

See above.

If you have any further queries, please feel free to contact me on sm.wood@surrey.ac.uk

Yours sincerely

Professor Steve Wood

Accredited by Association of MBAs

AACSB ACCREDITED

THE QUEEN'S ANNIVERSARY PRIZES FOR HIGHER AND FURTHER EDUCATION 2011

## Minutes of the discussion of Examiners' Reports at the EMEM Standing Committee

### STANDING COMMITTEE FOR EEM AND RELATED STUDIES

### Part II - Reserved

### CONCISE minutes of the meeting held on Thursday 31 October 2013

### 11. Internal and External Examiners' Reports for Examinations in 2013

#### 11.1. Chairman's Report for EEM Parts A, B and C

The Standing Committee received the Chairman's Report for EEM Parts A, B and C. No matters of concern were raised.

#### 11.2. MEM Parts I and II

The Standing Committee received the examiners' reports for MEM Parts I and II. No matters of concern were raised.

#### 11.3. External Examiners' Reports

The external examiners' reports were received from:

- Engineering: Professors Allen, Murray and Powrie.
- Economics: Dr Simpson
- Management: Professor Wood
- Materials: Professors Burke and Rainforth

The internal and external examiners reports were considered in detail and various comments by the externals noted. No specific actions were identified.