# CONFIDENTIAL

# EXAMINERS' REPORTS 2022
## MATERIALS SCIENCE (MS)

Internal Examiners' Reports

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# REPORT ON PRELIMINARY EXAMINATION IN MATERIAL SCIENCE

**Part I**

## A. STATISTICS

| Category | Number | | | Percentage | | |
|---|---|---|---|---|---|---|
| | 2021/22 | 2020/21 | 2019/20 | 2021/22 | 2020/21 | 2019/20 |
| Distinction | 9 | 12 | n/a | 20 | 27 | n/a |
| Pass | 25 | 27 | n/a | 57 | 61 | n/a |
| Fail | 10* | 5 | n/a | 23 | 11 | n/a |

*Nine candidates resat some or all the written papers in September.

**Marking of scripts**

Scripts are single marked except for borderline cases which are double-marked. In addition, the Chair selected some scripts at random across all papers to be double marked and to ensure consistency of marking.

## B. EXAMINING METHODS AND PROCEDURES

The conventions were updated last year and no further changes were made this year. Each Moderator was assigned the responsibility for setting and marking their principal paper, but they were also assigned a second paper from the outset. The aim was to ensure greater scrutiny of the papers and familiarity prior to second marking.

All topics were examined, but some questions required knowledge from more than one lecture course. This approach is in line with standard practice in Part I examinations. Lecturers were asked to provide draft questions in order to ensure that they examined material definitely presented to this year's cohort. The overall aim for lecturers in setting the difficulty of questions was such that students who achieve a mark of 70% or more "*show excellent problem-solving skills and excellent knowledge of the material over a wide range of topics, and are able to use that knowledge innovatively and/or in unfamiliar contexts.*"

## 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.

Materials Papers

In the past, some questions submitted by the lecturers needed modification because they were too predictable or because they contained some errors. As in 2021, the Moderators were pleased to note that most lecturers provided clear commentary alongside their worked answers, and in only a few cases did the questions and/or worked answers require small modifications by the Moderators. The return to closed book examinations allowed a corresponding return to a more conventional style of question, although large sections requiring regurgitation of lecture notes were avoided. The paper averages for MS1, MS2 and MS3 were 58.9%, 59.9% and 54.7% respectively, in line with past norms, but there were several very poor attempts at all 3 papers.

Maths Paper

The average mark on the Maths paper this year was 46.2%, much lower than in 2021 (54.8%). For the past two years Maths lecturers have been asked to introduce harder questions, especially to section B of the paper, in order to reduce the average paper mark which had become uncomfortably high, and so improve differentiation between students. However, this year the Maths paper proved a significant challenge for some of the students, as emphasised by the Moderator's comments in the paper report. There will be no reason for future moderators to aim to increase the difficulty of the Maths questions any further. In recognition of the relatively low marks average achieved in the maths paper, the moderators took a unanimous view that the threshold for passing should be set at 33% for this examination.

Coursework Paper
The coursework paper is made up of 50% from the first year practicals, 25% from the crystallography classes and 25% from the Computing for Materials Science course.

Computing for Materials Science (CMS)
The marks were reviewed and approved.

Crystallography coursework
The report from the Senior Demonstrator flagged no specific concerns.

Practicals
The Moderators considered a report from the Practical Courses Organiser (PCO) which outlined events throughout the year which may have impacted on the candidates' performance, and agreed that any action taken at the time had mitigated this impact.

The Moderators endorsed the PCO's recommended penalties as laid out in their report.

One candidate failed the practical class, and there were no mitigating circumstances recorded. One candidate was noted in the Practical Organiser's report as just passing the 40% threshold. Moderators agreed that this candidate had therefore passed practical work.

The Moderators considered the recommendation from the Practical Class Organiser to adjust the marks for 1P5 and decided to take no action on the basis that it would make no difference to the outcome of the examination for any of the candidates.

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

Circulation by Senior Education Officer to all students and tutors by e-mail and published on the Departmental website.

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

**Part II**

## A. GENERAL COMMENTS ON THE EXAMINATION

44 students were registered for the examination. All candidates took the same papers for the whole examination (both Trinity Term and Long Vacation papers). For the Long Vacation resits, one candidate took all four papers and one candidate took one paper online with remote invigilation.

30 candidates passed all papers without the need for any compensation, and under the conventions 3 further candidates were awarded compensated passes in the MS3 paper. Of these 33 successful candidates in June, 9 were awarded Distinctions, all with total average marks above 70%.

9 candidates failed at least one paper (and one failed the practical coursework as well). 8 of these took the long vacation resits in September. One of these candidates also missed two exams due to illness and sat these papers for the first time in September.

There were 2 minor errors in MS2 which were taken into account in marking the paper, and were not deemed to have impacted the candidate's performance.

Prizes for the best overall performance in Prelims were awarded to Ruidong Zhou, St Anne's College and James Bennett, Mansfield College. Prizes for the best performances in 1st year Practicals were awarded to James Bennett, Mansfield College and Evie Hargreaves, Queen's College. An additional prize for outstanding performance was awarded to Harry Wright, St Anne's College.

**Long Vacation examinations**

In the Long Vacation examinations, 6 of the 8 candidates passed all the papers they were resitting, as did the candidate taking two papers for the first time. 2 candidates failed 2 or more of the resit papers, and so are deemed to have failed the examination.

One question in the resit MS1 paper was on material that has recently been moved to MS2. This was an error in setting the paper, and the examiners considered how to deal with the marking of a paper where the candidates had a reduced choice of questions to answer. The agreed decision was to apply an appropriate scaling to all the MS1 scripts. Some of the supporting information was missing in one of the part B questions in the Maths resit paper, and again a scaling factor was applied to all the scripts to take this into account.

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

Where approved by the Proctors, 4 candidates were allowed (i) extra time on account of dyslexia / dyspraxia, and/or (ii) other special arrangements.

**Gender Issues:**

Of the 44 candidates 17 were women and 27 men.

2 of the 9 distinctions were awarded to women.

In view of the small overall number of candidates, it is not sensible to draw conclusions from these data for this year. However long term data (to allow for a bigger data set) on m/f distinction divide should be examined. The 2021-22 mean score showed no obvious gender bias: males 59% and females 54%.

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

## D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

This information is in the paper summaries attached.

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

There were four applications for special arrangements for the written papers:

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

**Mitigating circumstances**

There were ten applications to consider regarding Mitigating Circumstances: Notices to Examiners. All these were graded and their potential impact on the candidate taken into account by the examiners. Of these 10, the two most serious (graded as level 3) were received after the Final Board date, and deserve some special comment.

Both these cases had clearly been known to the colleges involved for many months before the examinations were sat. Despite this, the students were apparently not supported sufficiently closely to make sure that the MCEs were submitted on time, and neither was the documentation complete (no headers to identify source or destination of social media messages) nor well presented. One college stated that they could not verify the information in the student statement despite stating that they had been aware of problems for months. One of these candidates took some of the long vacation resit papers, and the college concerned had to be reminded to consider submitting another

MCE for this new examination.  The paperwork then submitted was what the Moderators should have had available at the end of Trinity Term, and made no reference to any problems experienced over the long vacation.  The Moderators view the quality of the support provided by the colleges to these two vulnerable students as **wholly unsatisfactory**.

The Moderators would like to put on record the wider point that the provision of MCEs after the board dates, MCEs with a lack of support from the college, and MCEs with no or insufficient medical evidence, make it increasingly difficult for an examination board to properly consider the impact of what may be very serious mitigating factors on the student performance.  This is especially true when the MCEs only arrive after the formal results have been released.

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

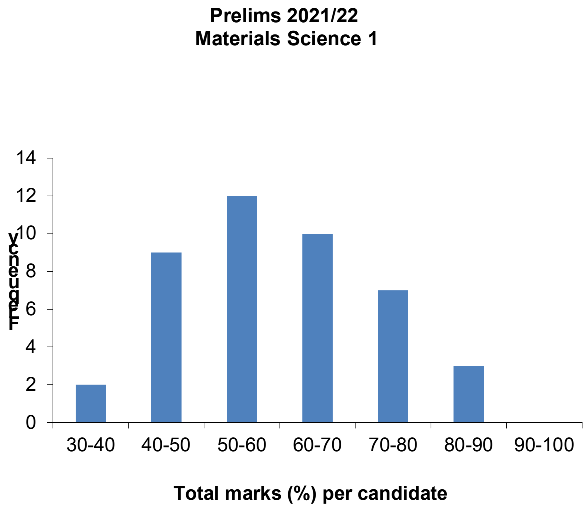
Professor D.E.J. Armstrong
Professor H. Bhaskaran
Professor C.R.M. Grovenor (Chair)
Professor A.I. Kirkland

## MS1 – Physical Foundations of Materials

**Examiner:** Prof. Angus Kirkland
**Candidates:** 44
**Mean mark:** 58.88
**Maximum mark:** 85
**Minimum mark:** 30

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 41 | 13.80 | 19 | 7.5 | The Study of Crystalline Materials by Diffraction |
| 2 | 30 | 11.32 | 20 | 6 | The Study of Crystalline Materials by Diffraction |
| 3 | 2 | 9.50 | 12 | 7 | Random Processes and Statistical Physics |
| 4 | 13 | 9.04 | 17 | 3 | Random Processes and Statistical Physics |
| 5 | 37 | 12.76 | 19 | 5 | Electromagnetic Properties and Devices |
| 6 | 37 | 12.08 | 19 | 3 | Electromagnetic Properties and Devices |
| 7 | 23 | 9.28 | 15 | 2 | Electromagnetic Properties and Devices |
| 8 | 32 | 11.17 | 16 | 4 | Wave Mechanics, Quantum Theory and Bonding |



**General comments:**

1) A very popular question generally very well answered. Several students achieved close to maximum marks and the lower marks were almost exclusively due to students not being able to answer part c on harmonic waves

2) A question of average popularity. Some students answered this very well, but the majority struggled with part b. In most cases they were able to identify the unit mesh but failed to identify the symmetry elements. The remaining parts of the question were well answered although a few students were not able to index the reflections in part d.

3) Only two answers to this question so statistical comments are not meaningful. Both answers were mediocre and failed on different parts of the question.

4) Another unpopular question with a low average mark. Part a-c were reasonably well answered but the majority of students struggled with the simple algebraic manipulations needed in parts d-f

5) A popular question that was, in the main well answered. No single part of the question was particularly badly answered but marks were frequently lost in part a where students had a tendency to make the derivation fit the required expression even when this was clearly wrong. Some students were not able to make the required connection of voltage in part d to that in the earlier sections.

6) Another popular question that was also well answered overall. Parts a and b(i) were well answered but a number of students were not able to derive the expression required in part b(ii). Many students were not able to correctly identify q as the key parameter in part c and hence failed to identify PZT as the optimum material.

7) A question of average popularity but generally not well answered. No single sections stood out as causing difficulties but the majority of answered lacked clarity and detail which lost marks for most students.

**8)** A reasonably popular question with average answers. The main loss of marks was in parts a(ii) where many students seemed to have difficulties with simple algebra and in part b where the sketches required lacked detail.

**Resits**

4 candidates sat MS1 as part of the September resits. It was noted that Q8 contained material that had moved to MS2 under the new syllabus and hence marks were renormalised by eliminating the lowest question mark for each candidate and rescaling the marks out of 80 to 100.

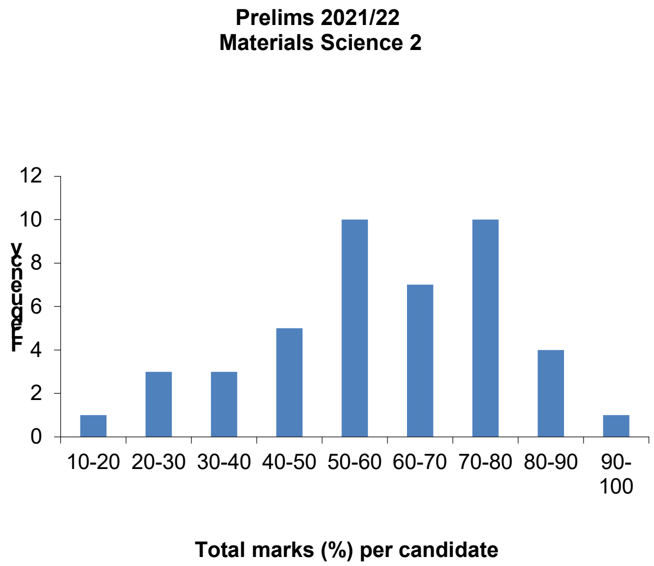
In general the questions were answered well and there was no significant variance between the marks obtained for the questions.

## MS2 – Structure and Mechanical Properties of Materials

**Examiner(s):** **Prof. Dave Armstrong**
**Candidates:** **44**
**Mean mark:** **58.66**
**Maximum mark:** **90**
**Minimum mark:** **16**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 40 | 12.24 | 19 | 3 | Defects in Crystals |
| 2 | 27 | 10.41 | 17 | 1 | Defects in Crystals |
| 3 | 20 | 10.10 | 17 | 1 | Mechanical Properties and Elastic Deformation |
| 4 | 26 | 10.19 | 20 | 2 | Mechanical Properties |
| 5 | 42 | 12.08 | 20 | 1 | Mechanical Properties |
| 6 | 29 | 12.83 | 20 | 2.5 | Elastic Deformation |
| 7 | 11 | 14.27 | 19 | 3 | Structures of Crystalline and Glassy Materials |
| 8 | 25 | 12.28 | 19 | 5 | Structures of Crystalline and Glassy Materials |



**General comments:**

1) A simple question on defects and dislocations which produced a range of answers. Poor candidates could not well define either vacancies or dislocations and showed little understanding about the formation of stacking faults. In d and e weak candidates could not compute a simple bit of crystallography. Strong candidates scored well on all parts.

2) A question on the observations of dislocations. Parts a and b were well done. Part c I was well done but the rest of the question challenged the students. Some candidates did very well on d. weaker candidates randomly multiplied numbers and hoped for the best.

3) Part a – Many students did not compare but just listed details. B- well done c- few candidates could state the need for a pre notch on another wise well polished sample, so allow K1C to be measured. C well done by most. D – only the best candidates could answer this

4) Materials selection question. Many students struggled to eliminate the correct variable. They also wanted to use all data in the table so tried to include yield stress in place of force. Few could explain how to plot and use and materials selection chart. Common mistakes – not using log scales, not explaining how to use the figure of merit on the graph to select the best material. Most knew the limitations of this approach.

5) A popular question. Some poor efforts to define slip plane and direction. Common issues ot c were confusing bcc and fcc slip systems and not understanding the difference in rotation between compression and tension. Surprising number of candidates couldn't find the angle between two vectors. Part d was very poorly done by most. Many simply wanted to state that the tensile samples had no stage 1 WH and to discuss why without a sensible looking graph. Many tried to relate it to fracture differences which scored no marks

6) An elasticity question. Some candidates struggled with the concepts in PI. In part b some candidates didn't not understand how to plot Mohrs circle for strain. Plotting the second strain as a shear strain. As this question is covered on the tute sheet (although it is a tough one) that was surprising. Good candidates got full marks. Common mistake was to not half the final angle.

7) Polymer part of the question required knowledge. Some candidates clearly didn't know about tacitly and couldn't get far with this. B, plotting the general poles was well done. Part c was well done

8) Ionic crystal question. Done well in a and b. student struggled with stereographic plot in c with many unsure how to centre on 111.

**Resits**

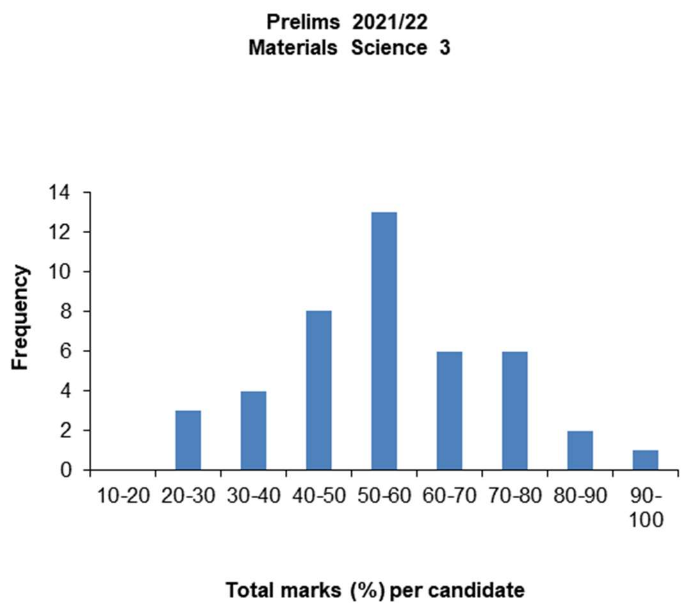
The paper scored a range of marks from 24 % to 71 %. Two candidates scored below 40% and thus failed. Similar issues as in the TT paper were seen with weak candidates unable to attempt all parts of 5 questions and having major gaps in their knowledge.

## MS3 – Transforming Materials

**Examiner(s):** **Prof. Chris Grovenor**
**Candidates:** **44**
**Mean mark:** **53.47**
**Maximum mark:** **90**
**Minimum mark:** **2**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 28 | 10.32 | 17 | 0 | Electrochemistry |
| 2 | 26 | 8.50 | 15 | 0 | Electrochemistry |
| 3 | 38 | 10.00 | 19 | 2.5 | Thermodynamics |
| 4 | 39 | 13.31 | 19 | 2 | Thermodynamics |
| 5 | 35 | 12.34 | 20 | 2 | Microstructure and Processing of Materials I |
| 6 | 27 | 9.78 | 18 | 1 | Microstructure and Processing of Materials II |
| 7 | 18 | 10.28 | 16 | 4.5 | Microstructure and Processing of Materials II |
| 8 | 7 | 8.93 | 17 | 2 | Introduction to Nanomaterials |



## General Comments

It was noticeable that while many candidates had a good grasp of the material, a few seemed extremely poorly prepared for this paper, with some exceptionally poor attempts at every question. Several candidates were unable to make attempts at 5 questions. 3 candidates were deemed to have failed to reach the pass mark.

These 3 candidates sat a resit paper, with 2 of them being awarded a pass mark and one failing a second time.

**Specific Comments on the TT paper**

1) A straightforward question on a simple cell with different Pb2+ ion concentrations. There was some confusion about deciding on the sign of the electrodes and which was the anode. Not many students gave the full Galvani representation (similar comment for Q2). Quite a lot of the answers successfully identified the open circuit potential, but fewer were able to make much progress with calculating the solubility product of PbSO4 (and none achieved the correct answer).

2) A lot of poor answers on this question, where many students could not identify the basic features of the chlor-alkali cell or attempt the calculation on the Tafel curve. Almost all the students who did make progress with the second part of the question did not plot the logarithm base 10 of the current density, and so did not get the correct numerical answers or report them in the correct (or often any) units.

3) A fairly standard question and popular on phase transformations in water. Some candidates could not draw the water phase diagram, even more did not know how to calculate enthalpy and entropy changes during temperature and phase changes, so parts e, e and f were much less well answered than the earlier sections.

4) A very straightforward and popular question on manipulation of basic thermodynamic equations that many of the students were able to answer with confidence and accuracy. The least well answered section was part d, where the wrong decision was made on whether the reaction goes further towards the products or not.

5) A popular question on constructing and reading phase diagrams, with a bimodal distribution of marks. The students found several ways of constructing incorrect diagrams from the information given driven by the urge to avoid peritectics. Those that did construct the diagram correctly gained very high marks by reading it accurately.

6) A fairly popular question on the thermodynamics of solutions. Again a bimodal distribution of marks, with some candidates having a very good grasp of the principles, and being able to draw relevant diagrams, and others with little understanding of the principles involved.

7) Not a very popular question on the applications of thermodynamics to phase transformations. Parts d and e on the Fe-C system were done much better than the earlier parts on the blast furnace and Ellingham diagram where there were many very confused answers.

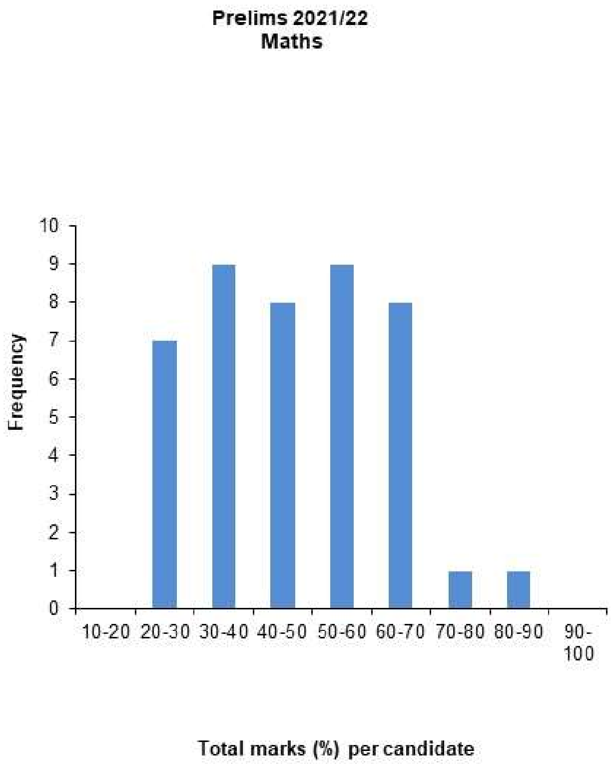
8) An unpopular question on nanomaterials. Most of the students who chose to answer it had something to say on the applications and problems with nanomaterials, but the synthesis and coarsening section was poorly done.

## Mathematics for Materials Science

**Examiner(s):** Prof. Harish Bhaskaran
**Candidates:** 44
**Mean mark:** 46.19
**Maximum mark:** 84
**Minimum mark:** 20

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Average mark (%) | Highest Mark | Lowest Mark |
|---|---|---|---|---|---|
| 1 | 38 | 5.47 | 68.4 | 8 | 0 |
| 2 | 30 | 3.32 | 41.5 | 8 | 1 |
| 3 | 43 | 5.97 | 74.6 | 8 | 2.5 |
| 4 | 22 | 3.95 | 49.4 | 8 | 0 |
| 5 | 42 | 5.12 | 64 | 8 | 1 |
| 6 | 40 | 4.33 | 54.1 | 8 | 1 |
| 7 | 37 | 5.18 | 64.8 | 8 | 0 |
| 8 | 43 | 5.72 | 71.5 | 8 | 1 |
| 9 | 24 | 2.17 | 27.1 | 6 | 0 |
| 10 | 38 | 6.53 | 81.6 | 8 | 2 |
| 11 | 9 | 9.17 | 36.7 | 22 | 0 |
| 12 | 9 | 4.67 | 18.7 | 6 | 2 |
| 13 | 31 | 12.21 | 48.8 | 24 | 1 |
| 14 | 39 | 9.82 | 39.3 | 24 | 1 |
| 15 | 38 | 14.49 | 58 | 23 | 2.5 |
| 16 | 24 | 13.90 | 55.6 | 25 | 0 |



**General comments:**

One candidate was unable to sit the examination. The exam paper was free of errors and no questions were raised in relation to the paper during or after the examination. The average mark was 46.19%, lower than the last examination, and very significantly lower than previous peaks of >80%. While such an outcome was desired, and the examiners concluded that this paper was not significantly harder than last year's, it reflects a level of preparedness that is lower than in previous years. The marks are normally distributed with a roughly Gaussian shape, and there appears to be a wide spread of outcomes, which is also reflected in the scores of other prelims papers. It is important to notice that all Part A questions and two Part B questions found at least one student able to work them out. For Part A questions, the average marks had a wide range of distribution – the lowest being just 11% on the limit of functions. This was a relatively straightforward question, and the low answer suggests a lack of understanding of limits in particular. Part B questions saw two problems, Q12 and Q14, placed at the low end of the marks, both lower than the 40% nominal threshold. The worst performance is observed for Q12 on Fresnel Integrals – surprisingly this was attempted by a larger number of students (9 students) than Q11, which was attempted by a mere 8 students. Q14 and Q15 was by far the most attempted but were not the ones with the highest marks. The parts that were left unanswered were mostly those that are not standard bookwork. Once again, this year, reflecting trends from last year, it is very clear that the most popular and neatly-answered questions were those on matrices and determinants, geometry, and deformations of solids. Although the level of mathematics examined is commensurate with the level of knowledge required for courses they will encounter in their second and third year, the examination was overall challenging.

**Specific Comments:**

1) Average 68.4%. Standard question on complex numbers. Relatively straightforward, and while most students could get started, they were unable to continue. While they did relatively well on this question, it was a little disappointing that such a standard question which was for the average student to score high marks on was missed.

2) Average 41.5%. This was an interesting question on polar coordinates and most students failed to spot that conversion to polar coordinates was required to be able to solve the problem. They also did poorly on the slightly more complex problem on the squircle which was to compute the jacobian, which indicated that they were unable to apply their knowledge to unfamiliar (although simple) problems. Completing the Jacobian in b) was quite ambitious for 5 marks, and marking was relatively lenient to reflect this.

3) Average 74.6%. This was a straightforward problem on the Maclaurin and Taylor series and most students did well on this one.

4) Average 49.4%. This was a problem to test the understanding of the students on limits of functions. The problem was set as a straightforward one, and most students were expected to answer this correctly, but the average is well below what would be expected. This is something to be flagged up to the course lecturers.

5) Average 64%. Once again, this was a straightforward problem on PDEs, and most students were able to do well on this problem. This did involve a few tricky derivatives and tested the students knowledge well.

6) Average 54.1%. Yet another question on PDEs, and surprisingly many students could not make much progress on the second part to a reasonable level. However, the stronger students were able to score full on this, suggesting that this was a well set question, and students that practised such solutions did well.

7) Average 64.8%. This was a straightforward question on solving a linear differential equation. The marks suggested that this was a well-set question which allowed the better students to

score full and the less prepared students scored less.

8) Average 71.5%. This was a question on linear algebra that most students were able to do well in. The question was not necessarily easy, although it was straightforward. Thus, it suggests that students really understood this material well and most did quite well on this question.

9) Average 27.1%. This was a question on gradients and testing their understanding of the physical meaning of this. Students scored very poorly on the conceptual understanding of this. Again this reflected what Question 2) above does, which is that students are unable to extrapolate their knowledge of the "procedure" to a new problem. This was not an easy question, but regardless, the scores suggest that not a single student was able to attempt this.

10) Average 81.6%. This was a very straightforward question on orientation of two planes and computing the angle between them. Many students were able to score a full on this question, and was the highest scoring question in Section A.

11) Average 36.7%. Attempted by 20%. This was a relatively unpopular question on roots of complex numbers, and most students did not attempt this question. Of those who attempted this question, the range of marks suggested that it was easy to score high on (highest was 22) or get it quite wrong (lowest was 4), suggesting that the question was well set.

12) Average 18.7%. Attempted by 20%. This question on fresnal integrals was not a popular one, and even those that attempted this scored poorly. The highest score on this question was 6, which suggests that the question was relatively difficult for most students. In retrospect, the question probably had too many sections that relied too heavily on one-another.

13) Average 48.8%. Attempted by 70%. This was a relatively popular question, and had a good range of marks for those that attempted this. This was a 4-part question on solutions to differential equations, and the highest score was 24 and the lowest was 1, suggesting that the question was set at the level that an averagely prepared student would score in the middle, which is also reflected in the average.

14) Average 39.3%. Attempted by 88%. This was one of the more popular questions and most students who attempted it seemed to have gotten the basic concepts reasonably correct, although they were not always able to compute the more conceptually difficult aspects such as incorporating Newton's laws into linear algebra. Overall, the question had the right balance of basics and advanced levels and this is reflected in the overall marks, where scores ranged from 24 to 1.

15) Average 58%. Attempted by 86%. This question was on matrix transformations, and was the most popular question in Section B. Most students who attempted it got many aspects of it correct (with a few exceptions). The highest score was 22 and the lowest 3, with a high average suggesting a good grasp of the fundamentals across most students in the cohort.

16) Average 55.6%. Attempted by 54%. Although not the most popular question, those who attempted this question on PDEs scored very highly. This question, especially part B was conceptual, and those who understood the basics were able to score the full 25, which reflects the high average for this question.

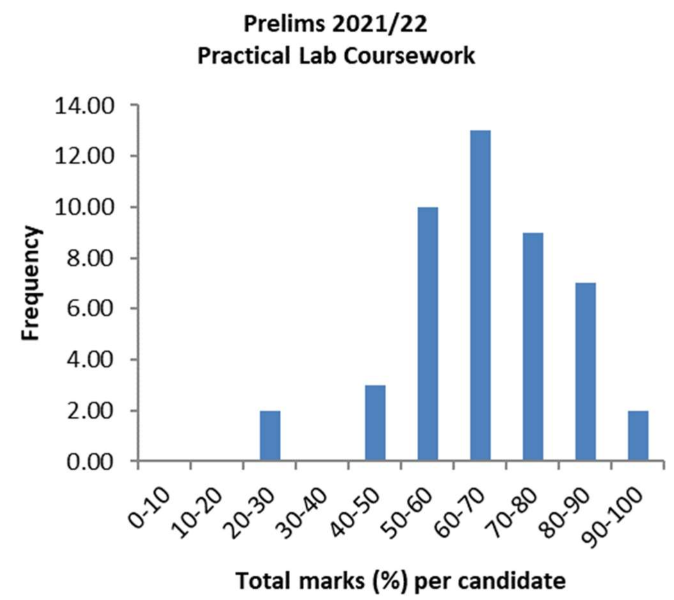
## Practical Lab Coursework

**Candidates: 44**
**Mean mark: 66.1%**
**Maximum mark: 90%**
**Minimum mark: 22%**

Detailed comments on the coursework are as follows:

| Lab No<br>Lab Book Assessment (/3) | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|
| 1P3 | 2.0 | 3.0 | 1.0 |
| 1P4 | 1.6 | 3.0 | 1.0 |
| 1P5 | 1.7 | 3.0 | 1.0 |
| 1P6 | 1.8 | 3.0 | 0 |
| 1P7 | 2.0 | 3.0 | 0 |
| 1P8 | 2.1 | 3.0 | 1.0 |
| 1P9 (not included) | n/a | n/a | n/a |
| 1P10 | 2.0 | 3.0 | 1.0 |

| Lab No<br>Lab Report Assessment (/13) | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|
| 1P3 (not assessed) | n/a | n/a | n/a |
| 1P5 | 7.3 | 13.0 | 2.0 |
| 1P8 | 11.0 | 13.0 | 6.0 |



## Report from the Practical Courses Organiser for 1st year Practicals 2021-22

I have reviewed the marks from the 1st year Practicals 2021-22. This year, after Covid19 restrictions were lifted, all practicals were in the labs. Those students self-isolating were offered an online version of the practical as a pre-recorded video accompanied by the datasets acquired for the students to work on. This resulted in a very low number of students missing practicals.

The lab notebook marks from 1P9 were not received due to the SD's personal situation and have been replaced by the average lab notebook mark from the rest of the practicals.

The lab notebooks were assessed for 8 practicals (although marks were not submitted for 1P9, due to SD not being able to mark). Out of a maximum of 3 marks, the average was 1.8, decreasing from 2.3 last year. Three practicals, 1P4, 1P5 and 1P6 had averages below 2. Practicals requiring reports averaged 9 marks over 13.

Overall, there was a broad range of average marks ranging from 30 to 84%, while last year they ranged from 34 to 91%. The average mark was 62% (vs 69% last year). Two students obtained an overall mark close to the 40% threshold needed to pass Prelims. I have reviewed their lab notebooks and reports and these are my comments:

- [redacted]

- [redacted]

The lab notebooks were assessed for 8 practicals (although marks were not submitted for 1P9).

- 1P7 – student too unwell to attend (med cert received) and student to submit MCE to explain absence.

- 1P6 - student too unwell to attend (med cert received) and student to submit MCE to explain absence.

- 1P9 marks have been averaged - Due to the ill-health of the SD, it was not possible for the lab notebooks to be marked before Prelims. An average mark calculated from the other lab notebook marks has been proposed.

- Lecture timings in week 1 Trinity Term - Pete's wave mechanics, Bonding and Quantum resulted in half of the students having the band gaps practical (Andrew Watt) before the lectures and the other half after the lecture. The SD was informed so that the effect on the discussion of the results could be minimised.

**Gender:** No significant differences between genders was observed

**Penalties:**

- No penalties were assigned for late submission of lab notebooks

-Some candidates submitted their reports ("-3" penalty) shortly after the deadline (up to 15min late). These penalties have been waived since they are likely it is the consequence of a technical delay or lapse and they would have not gained any additional academic advantage. This happened to 2 students in 1P3 (formative assessment) and 1 in 1P8.
1 candidate submitted late by over 2 hours, 1 candidate by 7 days and 1 candidate by 58 minutes, a 3 mark penalty has been applied to these submissions.

**Plagiarism:** No cases of plagiarism were reported by the senior demonstrators.

**Problems which occurred in the labs during the course of the year which the Moderators should be aware of as potentially affecting candidates' marks:**

- 1P5 SD's marking criteria was criticized by the students and the matter raised by JCCU representatives. The SD's approach was to penalize those students who didn't treat the 3 experiments of the practical as a whole, extracting joint conclusions. Many students, instead, submitted a report with almost 3 independent sub-sections. I sympathise with the SD, as some of the reports barely tell a story. The students also criticised the lack of detailed feedback. I have checked the first 15 reports and the feedback provided is detailed enough, in my opinion. However, the marks distribution is significantly lower than in the other reports this year, with the majority of them being 2-4, which is too harsh (again, in my opinion). I propose that 3 extra marks are added to every report so that the results align better with the other practicals (inducing a shift in the histogram to higher marks on average).

All other issues were dealt with by the SDs involved and subsequently sorted.

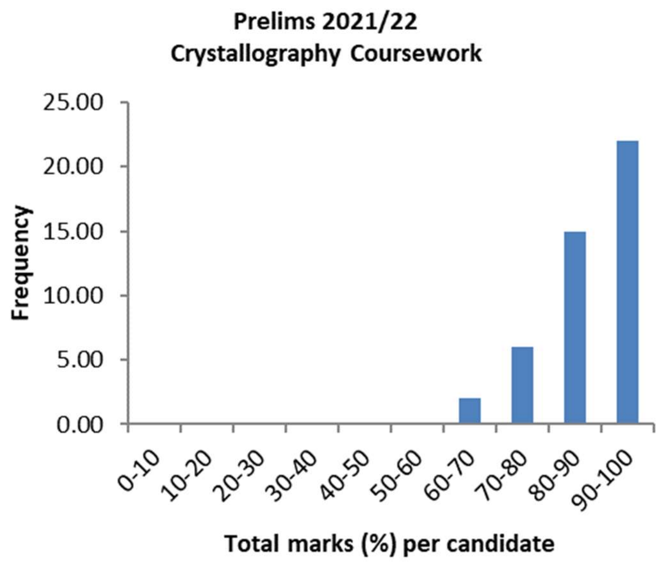
Practical Courses Organiser – Sergio Lozano-Perez
June 2022

## Crystallography Class Coursework

**Candidates:** **44**
**Mean mark:** **86.89%**
**Maximum mark:** **98%**
**Minimum mark:** **62%**

Detailed comments on the coursework are as follows:

| Demo No | Average Mark | Highest Mark | Lowest Mark |
|---|---|---|---|
| D2 | 9.3 | 10.0 | 7.1 |
| D3 | 7.5 | 9.6 | 2.9 |
| D4 | 8.9 | 10.0 | 5.8 |
| D5 | 9.1 | 10.0 | 7.1 |
| D6 | 8.6 | 10.0 | 5.0 |



## Report from the 1st year Crystallography Class Organiser for 2021-22

This year the crystallography classes were supervised in person by Dr Ed Darnbrough, Dr Ali Mostaed, Mr Leonhard Tannesia, and Mr Zonghao Guo. A team of four works well for the large class size but it is imperative that those demonstrators go over the sheet together prior to sessions to give a coherent response to the students. We typically meet in person or online the day before for 30-45 mins after each completing the sheet separately. To encourage this going forwards I would recommend adding some preparation time for the demonstrators.

This year saw a return to in person teaching of these classes following on from last year where adaptions had been made to allow for remote work over teams. The course has six classes supports both the Crystallography lectures and Structures of Crystalline and Glassy Materials course. The content and focus of each class has stayed the same but as with previous years the worksheets have undergone development to push the students a bit further and to pre-empt observed student stumbling blocks from previous iterations. Difficulty with delivery this year came from an unclear protocol for student illness. Early classes students informed the office or myself when they were ill or covid isolating allowing for me to set them the electronic version of the sheets developed in the same time period. However, latter classes saw students not attending and emailing (when prompted by me reaching out) either during or after the session asking to do the work remotely. To my knowledge there are still two outstanding issues regarding this. This adds extra work and stress on the senior demonstrators to chase students plus assisting (via teams) and assess both virtual and in person work. I think the course benefits for the option of remote work for those who have to isolate but I would suggest a deadline prior to classes for students to apply for this is implemented in future. An additional unintended consequence of running the course virtually is I suspect there are now the electronic versions of the sheets floating around the student population. I challenged one set of students using a sheet from last year but thankfully my changes were significant enough that in trying to use it they got themselves confused. I think this also highlights the need to keep evolving the worksheets.

I think the course is in a good place with 100% of respondents agreeing or strongly agreeing to the classes being useful and 88% saying they helped to understand the material covered in lectures. A useful suggestion to consider from the student feedback was “perhaps a class introducing the kinds of software that materials scientists use nowadays to aid with crystallography would have been beneficial.”

Each practical is worth 10 marks with those marks distributed sensibly across the questions posed. The guided nature of the class, along with the availability of lecture notes and textbooks, means a score of 70% or below on any one practical indicates that the student struggled with that practical. The worksheets and environment can be adapted to help students by printing different sizes and on coloured paper, to help with visualisation 3D models are provided both of different indice planes and different crystal structures. These models have been in the department for a long time and are held by Diana in the labs, consideration could be made on if they could be improved or added to. The online class material means that any student can alter the display of the information and to help with any disability that may inhibit spatial perception or spatial reasoning will likely struggle, an attempt was made to provide a number of digital 3D models but the success of this is unknown. One aspect of the course that could be considered is that it is heavily dependent on group communication, if a student disability were to make this difficult it could adversely effect their ability to benefit from the classes.

I attach the complete spreadsheet for crystallography practical marks for 2021/22. The large majority achieved good marks in the classes, with a final average grade of 89% across the year group. All students scored a final grade between 71 to 98%, with 26 scoring an average of over 90%. This I believe reflects well on the classes as being a learning environment rather than a testing one. For context, last year the marks ranged from 76 to 95%, with a mean of 86%. This suggests the change in delivery did not negatively affect the student’s ability to complete the work. It should be noted that as in previous years that all finished comfortably within 2hrs for the first class and around the 3hr mark for the following sessions suggesting the amount of content is suitable but consideration could be made of class 3 where the average mark was considerably lower than others. Conversations with students suggests that when in an active group they learnt a great deal which supported the other teaching by practicing theory and discussing it thoroughly with their peers.

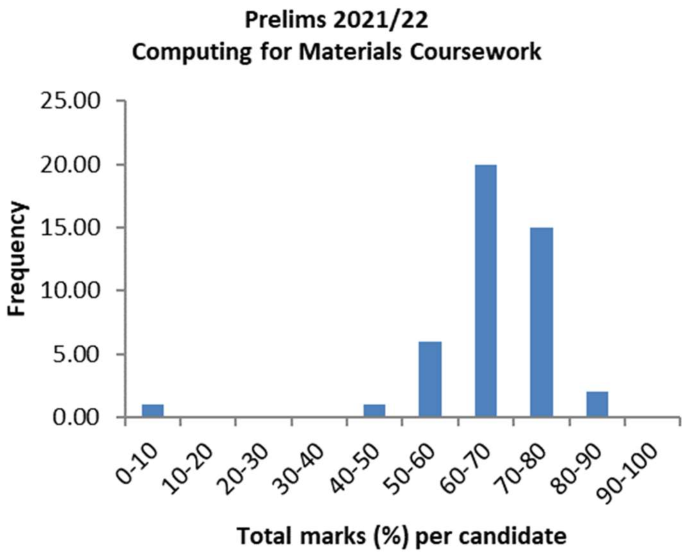
Yours Sincerely,

Ed Darnbrough
Crystallography Class Organiser
2021-22

## Computing for Materials Science

**Candidates:** 44
**Mean mark:** 65.82%
**Maximum mark:** 83%
**Minimum mark:** 49%

Detailed comments on the coursework are as follows:




### Report from the 1st year Computing for Materials Science convenor for 2021-22

The four classes were held in person this year in MT and HT. Due to the large size of the cohort we ran two parallel classes. The reduced number of students in the room seemed to improve the dynamics.

A good number of students had prior experience with computing. This has been a trend over recent years – this seems to improve the overall performance in the classes, as the student work together and share their knowledge.

We ran drop-in sessions (virtual and in-person) to answer questions related to the assessed projects. These were poorly attended, and we should consider if it is worth continuing these.

The quality of the assessed projects varied greatly. Writing the Matlab code was not typically an issue, rather it was the scientific investigation and presentation. Many reports presented only the basic results and did not fully investigate or discuss their findings.

Jonathan Yates
Computing for Materials Science course leader
2021-22

# Examination Conventions 2021/22
# Preliminary Examination in Materials Science

## 1. INTRODUCTION

Examination conventions are the formal record of the specific assessment standards for the course or courses to which they apply. They set out how examined work will be marked and how the resulting marks will be used to arrive at a final result progression decision and/or classification of an award.

These conventions apply to the Preliminary Examination in Materials Science for the academic year 2021/22. The Department of Materials' Academic Committee (DMAC) is responsible for approving the Conventions and considers these annually, in consultation with the examiners. 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 Examination Regulations may be found at: www.admin.ox.ac.uk/examregs.

The paragraphs below indicate the conventions to which the examiners 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 Education Committee of the University and the Proctors who may offer advice or make recommendations to examiners.

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 act on behalf of the University and in this role are independent of the Department, the colleges and of those who teach the MS M.Eng. programme.

## 2. RUBRICS AND STRUCTURE FOR INDIVIDUAL PAPERS

Each of the five papers in Prelims, comprising the three Materials Science papers (MS1, MS2 & MS3), the Maths for Materials Science paper, and the Coursework Paper, are weighted equally towards the overall total for the Preliminary Examination. The moderators set the papers, but are advised to consult the course lecturers. The course lecturers are required to provide draft questions and exemplar answers if so requested by the moderators. There are no external examiners for Prelims. The assessed work for the practicals, the crystallography classes and the project work for Computing in Materials Science (CMS) together constitute the Coursework Paper.

*Written Paper Format*

The Materials Science papers 1 - 3 comprise eight questions from which candidates must attempt five. Each question is worth 20 marks. The maximum marks available for each of these papers are 100.

The Maths for Materials Science paper consists of two sections, candidates are required to answer all questions in Part A and 4 from Part B. The total marks available for this paper are 180; the mark achieved then being weighted by a factor of 0.555' such that the paper contributes a maximum of 100 marks to the Preliminary Examination.

Examiners proofread the final 'camera-ready' pdf version of each examination paper. Great care is taken to minimise the occurrence of errors or ambiguities. Despite this care, on occasion an error does remain in a paper presented to candidates: if a candidate thinks there is an error or mistake in the paper, then they must state what they believe the error to be at the start of their answer to that question and if necessary, state their understanding of the question.

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* for the 2021-22 examinations the Nominating Committee comprised Prof Assender, Prof Marrow & Dr Taylor.

*Coursework paper*

The Coursework Paper comprises three examined elements of coursework: (i) for the Practical Course two full reports as specified in the MS Prelims Handbook, together with assessment of the student's laboratory notebook entries for each of the eight specified practicals also as detailed in the MS Prelims Handbook (normally these reports and notebook entries have been marked already as the practical course progresses); (ii) a set of reports for crystallography (completed under the class schedule); and (iii) project work for Computing in Materials Science.

For formal submission of the practical coursework, the Examination Regulations stipulate that candidates are required to submit the Materials Practical Class reports and laboratory notebooks to the Chair of Moderators by no later than 10 am on Friday of the sixth week of Trinity full Term. Further information on this is provided in the MS Prelims Handbook.

The only types of calculators that may be used in examinations are from the following series:

CASIO fx-83
CASIO fx-85
SHARP EL-531

Candidates are not permitted calculators in the Mathematics for Materials Science examination. A basic periodic table is provided in all Preliminary examinations and some Maths definitions and formulae are provided for the Maths examination. (These are available on Canvas).

## 3. MARKING CONVENTIONS

### *3.1 University scale for standardised expression of agreed final marks*

Agreed final marks for individual papers will be expressed using the following scale: 0-100

### *3.2 Qualitative criteria for different types of assessment*

*Qualitative descriptors, based on those used across the Mathematical, Physical and Life Sciences Division, are detailed below:*

| | |
|---|---|
| 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. The higher the mark in this band the greater will be the extent to which these criteria are fulfilled; for marks in the 90-100 range there will be no more than a very small fraction, circa 5-10%, of the piece of work being examined that does not fully meet all of the criteria that are applicable to the type of work under consideration. The 'piece of work' might be, for example, an individual practical report, a question on a written paper, or a whole written paper. |
| 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. |
| 50-59 | The candidate shows basic problem-solving skills and adequate knowledge of most of the material. |
| 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. |
| 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. |
| 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 |

### 3.3 Verification and reconciliation of marks

During the marking process the scripts of all written papers remain anonymous to the markers. Each written paper is marked by a single moderator. Those papers identified by the moderator as having marks close to the boundaries of pass/fail and distinction/pass will be fully marked by a second moderator, who has sight of the first moderator's marks, but arrives at a formal independent mark. If the difference in these marks is 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 moderators identify the discrepancy and read the answer again, either in whole or in part, to reconcile the differences. If after this process the moderators still cannot agree, they seek the help of the Chair, or another moderator as appropriate, to adjudicate. For all other papers, the second moderator checks that the overall mark for each question is consistent with one of three sets of descriptor(s), namely those for <40, 40 to 69, or >= 70 as appropriate. An integer total mark for each paper is awarded, where necessary rounding up to achieve this.

In the event that a possible error in the paper has been identified, the first moderator will consider the validity of the error and assess the impact of the error on candidates' choice of questions and on the answers written by those who attempted a question that contained an error, and will take this impact into account when marking the paper and prior to agreeing a final mark for all candidates.

First year practicals are assessed on a continual basis by the senior demonstrators. The work for the six crystallography classes is assessed by the Crystallography Class Organiser(s), the first of these classes being assessed formatively only. The project work for the Computing in Materials Science is assessed by the CMS senior demonstrator. Satisfactory performance in the practical work, in the crystallography classes, and in the CMS project work is defined in the MS Prelims Handbook. The Practical Class Organiser reviews the marks for the practicals before they are considered by the moderators, drawing to their attention (i) any anomalously low or high average marks for particular practicals and (ii) any factors that impacted on the practical course, such as breakdown of a critical piece of equipment. The moderators review the practical, crystallography and project marks.

### 3.4 Scaling

Adjustment to marks, known as scaling, normally is not necessary for prelims.

### 3.5 Short-weight convention and departure from rubric

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 the cover sheet which questions, up to the prescribed number, they are submitting for marking. Excepting section A of the Maths paper, for which all questions are compulsory, if this information is not provided then the examiners will mark the questions in numerical order by question number.

If the candidate lists more than the prescribed number of questions then questions will be marked in the order listed until the prescribed number has been reached. 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 above will be awarded and (iii) the mark for the paper will still be calculated out of 100 for MS1, MS2 & MS3 and out of 180 for the Maths for Materials Science paper.

### 3.6 Late- or non-submission of elements of coursework

**Including action to be taken if submission has been or will be affected by illness or other urgent cause, and circumstances in which academic penalties may be applied.**

The Examination Regulations prescribe specific dates and times for submission of the required elements of coursework to the Examiners (1. A set of five reports of crystallography coursework as specified in the MS Prelims Handbook (normally each individual report within the set has been marked already as the crystallography classes progress - penalties for late submission of an individual crystallography report are prescribed in the MS Prelims Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions.); 2. Two full reports of practical work as specified in the MS Prelims Handbook plus the student's laboratory notebook entries for the Prelims Practical Course (normally each individual report and laboratory notebook entries for each of the specified practical classes have been marked already as the Practical Course progresses - penalties for late submission of an individual practical report are prescribed in the MS

Prelims Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions); 3. Project work for Computing in Materials Science as specified in the MS Prelims Handbook.) Rules governing late submission of these elements of coursework and any consequent penalties are set out in the 'Late submission and non-submission of a thesis or other written exercise' clause of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations (Part 14, 'Late Submission, Non-submission, Non-appearance and Withdrawal from Examinations' in the 2021/22 Regulations). A candidate who fails to submit an element of coursework by a prescribed date and time will be notified of this by means of an email sent on behalf of the Chair of Moderators.

Under the provisions permitted by the regulation, late submission of an element of coursework, as defined above, for Materials Science examinations will normally result in one of the following:

a) Under paras 14.4 to 14.8. In a case where illness or other urgent cause has prevented or will prevent a candidate from submitting an element of coursework at the prescribed date, time and place the candidate may, through their college, request the Proctors to accept an application to this effect. In such circumstances the candidate is strongly advised to (i) carefully read paras 14.4 to 14.8 of the aforesaid Part 14, where the mandatory contents of such an application to the Proctors are outlined and the several possible actions open to the Proctors are set out, and (ii) both seek the guidance of their college Senior Tutor and inform at least one of their college Materials Tutorial Fellows. Some, but not all, of the actions open to the Proctors may result in the work being assessed as though it had been submitted on time (and hence with no late submission penalty applied).

b) Under para 14.9. In the case of submission on or after the prescribed date for the submission and within 14 calendar days of notification of non-submission and without prior permission from the Proctors: subject to leave from the Proctors to impose an academic penalty, 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 Moderators with due consideration given to the circumstances as advised by the Proctors. The reduction may not take the mark below 40%.

c) Under Para 14.4(4). In the case of failure to submit within 14 calendar days of the notification of non-submission and without prior permission from the Proctors: a mark of zero shall be recorded for the element of coursework and normally the candidate will have failed that element. As stated in the Special Regulations for the Preliminary Examination in Materials Science, failure of the coursework will normally constitute failure of the Preliminary Examination.

If a candidate is unable to submit by the required date and time for any reason other than for acute illness their college may make an application to the Proctors for permission for late submission. An extended deadline may be approved, or late submission excused where there are grounds of 'illness or other urgent cause'. Applications may be made in advance of a deadline, or up to 14 days from when the candidate is notified that they have not submitted. In all cases, the applications will be considered on the basis of the evidence provided to support the additional time sought.

*Elements of coursework comprising more than one individual piece of assessed coursework*

Penalties for late submission of individual practical reports and individual crystallography class reports are set out in the 2021-22 MS Prelims Handbook and are separate to the provisions described above.

The consequences of failure to submit individual practical reports or individual crystallography reports are set out in the MS Prelims Handbook (sections 10.6 and 11 of the 2021/22 version) and are separate to the provisions described above. In short, normally this will be deemed to be a failure to complete satisfactorily the relevant element of Materials Coursework and will therefore constitute failure of the Preliminary Examination as a whole, as stated in the Special Regulations for the Preliminary Examination in Materials Science.

Where an individual practical report or individual crystallography report is not submitted or is proffered so late that it would be impractical to accept it for assessment the Proctors may, exceptionally, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chairman of the Moderators, permit the candidate to remain in the examination. In this case for the individual piece of coursework in question (i) the Moderators will award a mark of zero and (ii) dispensation will be granted from the Regulation that requires submission/delivery of every individual piece of assessed coursework if the candidate is not to fail the examination as a whole.

### *3.7 Penalties for over-length work and departure from approved titles or subject-matter*

This is not applicable to the Prelims examination.

### *3.8 Penalties for poor academic practice*

Substantial guidance is available to candidates on what constitutes plagiarism and how to avoid committing plagiarism (see Appendix B of the Materials Prelims Handbook and https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism)

If plagiarism is suspected, the evidence will be considered by the Chair of the Moderators (or a deputy). He or she will make one of three decisions (http://www.admin.ox.ac.uk/media/global/wwwadminoxacuk/localsites/educationcommittee/documents/policyguidance/Plagiarism_procedures_guidance.pdf ):

(a) No evidence, or insufficient evidence, of plagiarism – no case to answer.

(b) Evidence suggestive of more than a limited amount of low-level plagiarism – referred to the Proctors for investigation and possible disciplinary action.

(c) Evidence proving beyond reasonable doubt that a limited amount of low-level plagiarism has taken place – in this case the Board of Moderators will consider the case and if they endorse the Chair's judgement that a limited amount of low-level plagiarism has taken place will select one of two actions:

  (i) Impose a penalty of 10% of the maximum mark available for the piece of work in question and a warning letter to be issued to the candidate explaining the offence and that the present incident will be taken into account should there be a further incidence of plagiarism.

  For a student who remains on course in addition there will be a requirement to demonstrate to their college Materials Tutorial Fellow that in the period between the present offence and the next submission of work for summative assessment they have followed to completion the University's on-line course on plagiarism (https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism).

  (ii) No penalty, but a warning letter to be issued to the candidate explaining the offence, indicating that on this occasion it has been treated as a formative learning experience, and that the present incident will be taken into account should there be a further incidence of plagiarism. For a student who remains on course in addition there will be a requirement to demonstrate to their college Materials Tutorial Fellow that in the period between the present offence and the next submission of work for summative assessment they have followed to completion the University's on-line course on plagiarism (https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism).

### *3.9 Penalties for non-attendance*

Unless the Proctors have accepted a submission requesting absence from an examination, as detailed in Section 14 of the Regulations, failure to attend an examination will result in the failure of the assessment. The mark for any resit of the assessment will be capped at a pass.

# 4. PROGRESSION RULES AND CLASSIFICATION CONVENTIONS

## *4.1 Qualitative descriptors*

Qualitative descriptors, based on those used across the Mathematical, Physical and Life Sciences Division, are given below:

| | |
|---|---|
| 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. |
| 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. |
| 50-59 | The candidate shows basic problem-solving skills and adequate knowledge of most of the material. |
| 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. |
| 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. |
| 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 |

## *4.2 Final outcome rules (Distinction, Pass, Fail)*

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.

## *4.3 Progression rules*

*To pass the examination and progress to Part I, candidates are required to satisfy the moderators in all five papers, either at a single examination or at two examinations in accordance with the re-sit arrangements detailed below.*

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.

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.

## *4.4 Use of Vivas*

There are no vivas in Prelims.

## 5. RESITS

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

Candidates who pass the coursework paper and fail more than two written papers will be asked to resit all four 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 prohibited from progressing to Part I. Exceptionally, a college may allow a student to suspend studies 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.

The mark for any resit required due to non-attendance will be capped at a pass.

## 6. MITIGATING CIRCUMSTANCES NOTICES TO EXAMINERS (MCE)

[For **late- or non-submission** of elements of coursework, including cases due to illness or other urgent cause, see section 3.6 of the present Conventions.]

A candidate's final outcome will first be considered using the classification rules/final outcome rules as described above in section 4. . The exam board will then consider any further information they have on individual circumstances.

There are two applicable sections of the University's *Examination Regulations*.

• **Part 13 Mitigating Circumstances: Notices to Examiners** relates to unforeseen circumstances which may have an impact on a candidate's performance.
• **Part 12 Candidates with Special Examination Needs** relates to students with some form of disability.

Whether under Part 12 or Part 13, a mitigating circumstances notice to examiners should be submitted by the candidate through student self-service/eVision, or by the college on behalf of the candidate as soon as circumstances come to light. Candidates with alternative arrangements under Part 12 will not be considered under this mitigating circumstances process if they do not submit a separate mitigating circumstances notice.

Where a candidate or candidates have made a submission, under Part 12 or Part 13, that unforeseen factors may have had an impact on their performance in an examination, the moderators will meet to discuss the individual notice and band the seriousness of each notice on a scale of 1-3 with 1 indicating minor impact, 2 indicating moderate impact, and 3 indicating very serious impact.

Normally, this MCE meeting comprises two parts: Part A and Part B. Part A will take place before the meeting of the moderators at which the examination results are reviewed. When reaching these decisions on MCE impact level, the moderators will take into consideration, on the basis of the information provided to it, the severity and relevance of the circumstances, and the strength of the evidence. Moderators will also note whether all or a subset of written papers and/or elements of coursework were affected, being aware that it is possible for circumstances to have different levels of impact on different written papers and elements of coursework. The banding information is used at Part B of the MCE meeting: in Part B a candidate's results are discussed in the light of the impact of each MCE and recommendations formulated regarding any action(s) to be taken in respect of each MCE.

Further information on the procedure is provided in the *Examination and Assessment Framework, Annex E* and information for students is provided at https://www.ox.ac.uk/students/academic/exams/problems-completing-your-assessment. It is very important that a candidate's MCE submission is adequately evidenced and, where appropriate, verified by their college; the University forbids the Board of Moderators from seeking any additional information or evidence.

## 7. DETAILS OF EXAMINERS AND RULES ON COMMUNICATING WITH EXAMINERS

The Moderators in Trinity 2022 are: Prof. David Armstrong, Prof Harish Bhaskaran, Prof. Chris Grovenor (Chair) and Prof, Angus Kirkland. 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 your college, who will, if the matter is deemed of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Prelims.

## ANNEX

**Summary of maximum marks available to be awarded for different components of the MS Preliminary Examination in 2022:**

| Component | Mark |
|---|---|
| Materials Science 1: Physical Foundations of Materials | 100 |
| Materials Science 2: Structure and Mechanical Properties of Materials | 100 |
| Materials Science 3: Transforming Materials | 100 |
| Mathematics for Materials Science | 100 |
| Coursework Paper: | |
| Crystallography Classes | 25 |
| Practicals | 50 |
| Computing in Materials Science | 25 |
| ***Total*** | ***500*** |

# 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 | | |
|---|---|---|---|---|---|---|
| | 2021/22 | 2020/21 | 2019/20 | 2021/22 | 2020/21 | 2019/20 |
| Distinction | n/a | n/a | n/a | n/a | n/a | n/a |
| Pass | 41 | 41 | 30 | 100 | 100 | 100 |
| Fail | 0 | 0 | 0 | 0 | 0 | 0 |

(2) **If vivas are used**
As stated in the Examination Conventions, vivas are not 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

**Exam format:**
The 2022 Exams were sat in closed book format in Examination Schools, as had been decided to be the preferred format by Faculty in MT 2021.
Students were advised in MT 2021 that, due to the uncertainty regarding COVID-19 at the time and their need to plan their revision, papers would be prepared such that they would be unchanged in the event that exams had to be carried out remotely and in open book format.
As per the 2021 exams, the University operated no exam paper corrections process during the 2022 exams whereby candidates could raise queries about potential errors within the first 30 minutes and receive feedback from an examiner; instead candidates were instructed to note any suspected error in their scripts so that examiners could assess and, if necessary, make adjustments when marking. In the event, no mistakes were identified by the students in any of the papers.

**Digital marking**
Following the precedent of digital marking in 2020 and 2021, it was agreed to scan all candidate manuscripts this year to pdf files for marking. A team of three graduate students were hired for this purpose and a second scanner purchased. After a test run in Hilary Term, a written procedure was produced for the efficient scanning of the manuscripts. The scanning process was carried out the day after each exam paper (taking about four hours) and the pdfs were available for marking by the evening of the day following the exam. An Examiner was present at all times during the scanning process to ensure security of scripts and answer any queries from the scanning team regarding anomalies in the scripts. This was found to be an efficient, accurate and comprehensive process, which led to a convenient set of pdfs saving time for the markers.

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

As in previous years, in 2022 the marking of scripts was a very time-consuming process. Starting in the 2023 exams, this load will be lightened somewhat for examiners by the introduction of course lecturers as ‘marker 1’ for each of the questions on the four General Papers. The 2022 Examiners would like Faculty to consider a further change to a ‘Marker plus checker’ model, where papers are single marked by the course lecturer and these marks are checked at an appropriate level, rather than full ‘double marking’.

The Examination and Assessment Framework states that double marking must be used “with the exception of papers with precise model solutions”. Other comparable MPLS departments such as Engineering Science and Physics make use of this exception and single mark their papers, and it would therefore be appropriate to review whether Materials should do so. The basis for a review would be to determine whether the model answers in Materials papers meet, or could be made to meet with reasonable additional effort, the criterion of ‘precise model solutions’. Comparison should be made with model answers in other subjects where single marking is used.

It may be helpful to note here that there was not unanimity on this point within the 2022 Board of Examiners, and it was pointed out that this criterion might be harder to meet for some of the more ‘essay style’ questions. A review could pay particular attention to this point and how model answers for similar question styles are handled in other subjects.

### D. EXAMINATION CONVENTIONS

Examination Conventions were issued to all of the candidates, sent electronically along with other information in a letter from the Chair of Examiners. The Examination Conventions were agreed by the Board of Examiners and the Department’s Academic Committee.

### E. STUDENT COMPLAINT

A complaint by a group of students regarding the preparation and advice they had received in advance of the Part I written examinations was received by the Examiners via the Proctors’ Office. The complainants claimed that the cohort had been disadvantaged by this advice, and in a way that the normal procedures for scaling of marks would not address. They requested that on this basis special consideration be given to the scaling of papers.

Since some of the advice in question had been given by examiners, the Chair of Examiners sought an independent view on the merit of the complaint from a senior academic in the department, Professor Martin Castell, who was not an Examiner and was not part of the subject of the complaint. Professor Castell reported his view to the Examiners in a report (for which the Chair would like to record his thanks here) which is available to view on request.

Based on the independent view of the merits of the complaint and their own assessment, the Examiners judged that no special consideration was warranted and that the normal procedures for scaling of marks should apply.

## Part II

### A. GENERAL COMMENTS ON THE EXAMINATION

There were 41 candidates for the examination, all of whom had achieved an Honours Pass in Part I, the majority could progress to Part II with one exception as one candidate failed to meet criteria to progress but has achieved Honours Pass. The candidate will therefore be able to graduate with a BA(hons) degree or resit exams to achieve the progression requirements. The examination consisted of six 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. Nine candidates opted to take a Supplementary Subject; four 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 a compulsory Introduction to Materials Modelling course and either a module on Materials Characterisation (twenty candidates) or a module on Atomistic Modelling (twenty-one candidates).

Each written paper lasted three hours. For the General Papers, candidates were required to answer five questions out of eight, as in previous years. For the Options Papers, candidates were offered ten questions in five sections each containing two questions; candidates were required to answer four questions, one from each of three sections and one from any of the same three sections.

Written papers were double-blind marked in the usual way. Each General Paper question was marked by two Examiners while the Options Paper questions were marked by the course lecturer (if not an

Examiner then appointed as an Assessor) and an Examiner. Raw marks were reconciled in the usual way.

Team Design Projects were marked by two Examiners. Teams were marked as groups. The allocation of bonus or penalty marks is permitted under the Conventions, and indeed three candidates were marked up by 2 marks each.

The Business Plans, submitted in the second year, were marked by an Assessor Oxford Medical Sciences Division and an Assessor appointed to represent the Faculty of Materials, again with teams being marked as a group.

Candidates' work on the two coursework modules was marked by two Assessors. One of the Examiners reviewed the marks for a number of representative scripts from both modules to ensure consistency between them, but felt that no further moderation of marks was necessary.

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

The average raw marks for all papers were in the upper 2:2 and low 2:1 range; paper averages for GP3, GP4 and OP1 were 60% or below. The raw paper mean mark was 62.98%. In the 2022 Part I exams the following scalings were applied to marks for the written papers following the procedures set out in section 3.4 of the Examination Conventions:

Following procedure (a), a scaling of +2 was applied to marks for GP3

Following procedure (b), a further scaling of +2 was applied to marks for GP3 and a scaling of +3 was applied to marks for GP4.

No further scaling was applied following procedure (c).

As part of the consideration of Mitigating Circumstances (as per Annex E of the university Examinations and Assessment Framework), a further scaling of +3 marks was applied to all written papers on the basis that the 2022 Part I cohort had not had the benefit of sitting Prelims examinations at the end of year 1, which the Examiners deemed to be a *disruption to teaching and learning*.

The scaled paper marks were GP1 64.90, GP2 65.37, GP3 60.32, GP4 61.68, OP1 63.39, and OP2 64.59. The scaled overall mean mark for Part I was in the mid-2:1 range at 66.10%.

## 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 62.6%, F 64.3% (Overall 63.4%)
Coursework Averages – M 72.8%, F 77.7% (Overall 75.1%)
Overall Part I Averages – M 65.1%, F 67.7% (Overall 66.3%)

Insofar as can be judged from the small sample size, the performance of male and female candidates on the written papers was not significantly different. This statement is based on the difference in the average mark between male and female candidates being 1.7% compared with the standard errors in the written paper averages, which was ±2.3% points for the male candidates and ±2.5% points for the female candidates. In coursework the female candidates again performed better, and the difference appears statistically significant – the difference in average marks was 4.9% compared with standard errors of 1.2% and 0.9% respectively. The better performance of female candidates than male candidates in coursework continues a trend noted in previous years Examiners' reports and appears to be becoming more pronounced.

Students with SpLDs were given time extensions in the normal way.

| | Overall mark | | Written Examinations | | Coursework | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 30-40 | - | - | - | - | - | - |
| 40–50 | 2 | - | 2 | 2 | - | - |
| 50–60 | 3 | 3 | 6 | 5 | - | - |
| 60–70 | 12 | 10 | 10 | 8 | 5 | - |
| 70–80 | 4 | 5 | 3 | 3 | 15 | 14 |
| 80–90 | 1 | 1 | 1 | 1 | 2 | 5 |
| 90-100 | - | - | - | - | | - |
| Totals | 22 | 19 | 22 | 19 | 22 | 19 |

**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**

Medical certificates were received from one candidate to cover absence from practical labs. These were considered by the Proctors who excused the candidate from the respective assessment. The examiners considered the mechanism as proposed by the Practical Class Organiser for calculating the average practical mark for each candidate and, following endorsement by the external examiners, employed this approach.

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For the written examinations, twenty-two applications for consideration of Mitigating Circumstances: Notices to Examiners were received. Case ii was considered to have had serious impact, cases iii, xi, xii, xiii, xv, xvi, xvii, xviii, xxi, xxii, xxiii and xxv were considered to have had moderate impact while cases iv, v, vii, viii, ix, x, xiv, xix, and xx were deemed to have generated only minor impact. The Examiners considered each case carefully and a fair course of action was agreed. There was one case of a student being unable to sit two examination papers due to illness for which the Proctors advised the Examiners of their options and for which it was elected to excuse the candidate from these papers and used the average mark obtained by the student in her General papers in their place.

All processing of Part I MCE applications was documented in the MCE reports to be made available to Examiners for Part II.

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

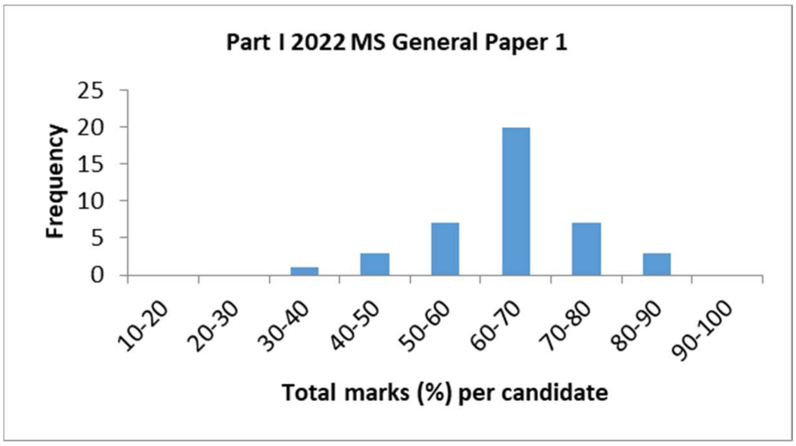
| | |
|---|---|
| Prof. S.C. Benjamin | Prof. K.A.Q. O'Reilly |
| Prof. S. Lozano-perez | Prof. P.D. Nellist |
| Prof. T.J. Marrow | Prof. J.M. Smith (Chair) |
| Prof. G. Williams (External) | Prof. P.D. Haynes (External) |

## GP1 – LIFESTYLE, PROCESSING & ENGINEERING OF MATERIALS

**Examiner:** Prof. James Marrow
**Candidates:** 41
**Mean mark:** 66
**Maximum mark:** 86
**Minimum mark:** 38

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 36 | 12.81 | 17.5 | 3.5 | Materials selection |
| 2 | 38 | 13.83 | 17 | 8 | Materials selection |
| 3 | 24 | 12.85 | 16.5 | 9.5 | Materials life cycle |
| 4 | 34 | 12.41 | 16.5 | 7 | End of Life |
| 5 | 39 | 12.08 | 19.5 | 5 | End of Life |
| 6 | 18 | 9.39 | 15 | 5 | Materials Processing |
| 7 | 14 | 9.96 | 16 | 1.5 | Materials Processing |
| 8 | 2 | 14.50 | 18 | 11 | Materials Processing |



## General Comments

This was the first year with the new structure of GP1, so no direct comparison is made with the previous year. The questions required understanding and application of the course content, and there were no significant differences in the apparent difficulty, indicted by the range of marks obtained. Questions 1 to 5 on Materials Selection, Life Cycle and End of Life were attempted by most candidates, with questions on Materials Processing done by fewer students. Question 8 (Materials Processing) was only attempted by 2 students, one of whom obtained nearly full marks. There was a general tendency for answers to be given at a superficial level, or with a lack of the expected detail or supporting explanations that final year students should be aware of.

Questions:

1)

1) Well answered by most, though some did not comment on potential role of heat/UV in initiation and some explanations of termination mechanisms were sketchy.
2) Basic concept given well by most, but many lacked detail on migration of the reaction point along the chain, or the role of multiple double bonds in the monomer itself for networks.
3) There was an error in the molecule (one of the CH2 should have been CH), but this did not affect the answer required. Many of the offered reactions did not clearly identify the broken double bond, identify the role of the N3+, or propose a clear termination reaction. The discussions on block co-polymers were often vague (e.g. linear chains and controlled molecular weight are useful in phase separating systems for control of morphology size).

2)

1) Most gave a fair overview, but with details missing on iteration (material class then specific materials), the wider range of materials, environmental and manufacturing parameters and interactions with the design process and component geometry.
2) Generally clear, but most had limited detail on disadvantages of composites (e.g. recycling, internal strains, joining, disposal/recycling) and focussed only on general processing and anisotropy issues.
3) Most were imprecise on definitions of objectives, constraints and variables, with many thinking that ceramics were suitable for structures loaded in tension (low tensile strength is a common property of these materials) or that wood was suitable for manufacturing a cable. The calculation was usually correct, with some noting possible challenges of a 90% volume fraction of fibres, but wider factors such as aesthetics, total mass and other properties were not considered.

3)

1) Most answers were quite limited by the range of properties considered.
2) Few considered the different mechanical properties of the two polymers and many did not address the aluminium satisfactorily as a gas barrier ii) the discussions of the environmental concerns were quite superficial with little reference to materials science issues.
3) Discussions and proposals were fairly superficial and did not contain much materials technical information at the level expected at final year.

4)

1) The discussions on the mechanisms of pitting and intergranular corrosion of sensitised boundaries were often superficial and lacking in detail, with the proposed solutions not well described or justified (i.e. consideration of counter factors such as cost or practicality at this scale).
2) As in a), the descriptions of the mechanism of crevice corrosion and solutions were sometimes superficial, and many only gave one distinct method to prevent the problem.

5)

1) Quite a few answers were superficial in the level of detail and justification and did not fully explain the principles of the protection mechanism, with some methods of implementation quite inappropriate for the application in terms of cost, scale, required reliability or environmental conditions. Quite a few did not recall that aluminium is self-passivating.
2) Generally well done, with occasional numerical errors.

6)

1) Few fully described the advantages of closure of porosity and strain hardening
2) All correctly identified the billets and gave generally correct descriptions of the crude differences between curves, but none discussed their interactions with the die lubrication. The calculations of the shear stresses were mostly done incorrectly without proper consideration of shear forces acting on the truncated cone of the die (which needed to be resolved into the axial direction), or along its cylindrical section (the axial force decreases in proportion to the length of material in the die).
3) Some failed to identify the redundant work of deformation or properly explain its effect on dislocation density and grain texture.

7)

1) Most gave the correct process, but descriptions were quite superficial in detail.
2) Generally well argued from dimensional principles.
3) Most identified the higher cost of vacuum equipment for electron beams, but did not consider that lasers can be more finely focussed for better surface finish.
4) Many did not recognise that the steep thermal gradient gives columnar grain growth and hence texture.
5) Most recognised that single crystal components would be extremely difficult to produce but did not present clear arguments based on the pattern of heat transfer set up from the solidification of a large number of melt pools of small size.

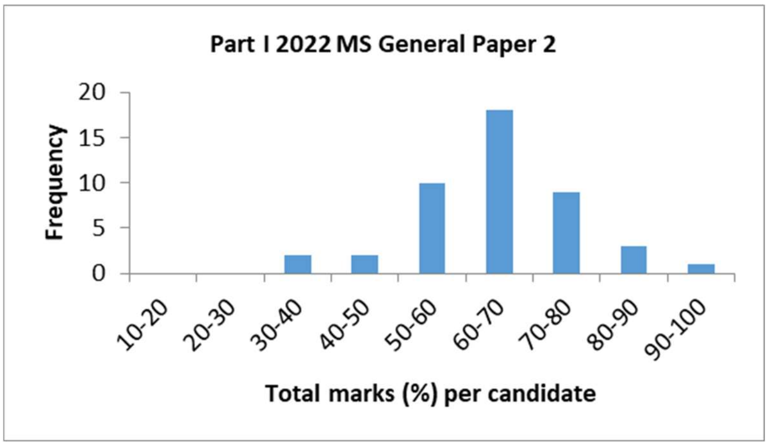
8) Too few candidates attempted the question to comment on trends.

## GP2 – ELECTRONIC PROPERTIES OF MATERIALS

**Examiner:** **Prof. Jason Smith**
**Candidates:** **41**
**Mean mark:** **66**
**Maximum mark:** **93**
**Minimum mark:** **32**

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 33 | 12.94 | 18.5 | 8 | Electronic structure |
| 2 | 34 | 12.85 | 18.5 | 5.5 | Electronic structure |
| 3 | 39 | 10.85 | 16.5 | 7 | Magnetic Properties |
| 4 | 23 | 13.54 | 20 | 4 | Magnetic Properties |
| 5 | 39 | 13.73 | 19 | 6.5 | Semiconductor materials |
| 6 | 5 | 6.70 | 12 | 3 | Semiconductor materials |
| 7 | 18 | 12.39 | 20 | 5 | Electrical & Optical Properties |
| 8 | 13 | 11.96 | 16.5 | 5 | Electrical & Optical Properties |



## General Comments

The paper was one of the higher scoring this year and had a raw average mark of 63% before scaling. The distribution of marks was somewhat wider than usual, with four candidates scoring below 50% and four above 80%. As last year, the reduced reliance on regurgitation of lecture notes posed challenges for the candidates who struggled to demonstrate their understanding. There was less evidence this year of students failing to complete five questions in the allotted time.
The new coverage of the paper following the year 2 course revisions, with four lecture courses rather than five and two questions from each course, arguably provides a better range of topics for examiners and choice of questions for candidates.

Questions:

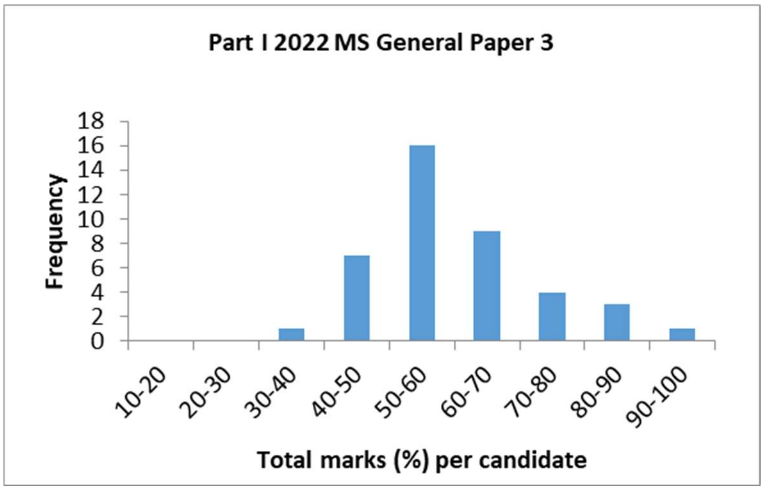
1) A popular question on the tight binding model which was generally well done. Most mistakes were careless errors in working out band parameters and difficulties in extending to 2D in parts (d) and (e).
2) A popular question on the free electron gas model, also generally well done. Few students took the direct route to the average electron energy in part (b), and some students struggled with parts (d) and (e) on the energy correction, but there were several good answers that scored high marks.
3) A question on para- and ferro-magnetism. The most popular question on the paper but with a low average mark. Part (a) required some understanding of paramagnetism and manipulation of the Brillouin function and was generally well done. Part (b) was less well done however: while most students were able to apply Hund's rules to nickel, few were able to use the g-factor to work out the allowed magnetic moments and none were able to correctly answer biii) on the nature of ferromagnetism in face-centred cubic nickel.
4) A question on superconductivity attempted by about half the candidates which attracted the second highest average mark on the paper. Candidates showed good understanding of the concepts tested in parts (a) and (c). Most marks were lost in part (b) where students had to solve a (quite simple) differential equation and relate it to a physical system.
5) A question on semiconductors – the most popular and highest scoring question on the paper. Parts (a) and (b) were straightforward bookwork and generally answered well, although several candidates did not know how the depletion width of the p-n junction relates to bias. Part (c) on electron transport was also generally well answered with most students able to construct the equation for mobility in terms of the scattering time and to explain key trends in mobility data.
6) A very unpopular question on MOSFET devices with a very low average mark. Few marks were obtained for the sections beyond reproducing the energy band diagrams of the device in the 'on' and 'off' states. This suggests a lack of familiarity among students with some basic concepts such as parallel plate capacitance and the position of the Fermi energy in doped semiconductors and/or a lack of confidence to apply their knowledge. The unfamiliar equation at the beginning of the question may have put some students off from attempting it.
7) A question on electrical properties of materials attempted by just under half the candidates and done moderately well. Most students did a good job of identifying the primary conduction mechanisms and temperature dependencies in part (a). Part (b) was done well by some, but many missed identification of the high temperature limit and made heavy weather of the equation given.
8) A relatively unpopular question on electrical polarisation of materials, but which was done reasonably well by many. Answers to Part (a) were generally good, while part (b) elicited some interesting answers and some over-long calculations showing lack of familiarity with the basic concepts. Manipulation of the Lorentz oscillator equation in parts c and d was generally good. Few students made any headway with part (e) suggesting lack of confidence in applying mathematical methods (in this case a series expansion) to physical equations.

## GP3 – MECHANICAL PROPERTIES OF MATERIALS

**Examiner:** Prof. Sergio Lozano-perez
**Candidates:** 41
**Mean mark:** 58
**Maximum mark:** 92
**Minimum mark:** 34

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 32 | 11.06 | 19 | 4 | Plastic Deformation of Materials |
| 2 | 32 | 11.55 | 18.5 | 3 | Elastic Deformation of Materials |
| 3 | 13 | 10.12 | 14 | 6.5 | Plasticity of Materials |
| 4 | 34 | 13.06 | 19.5 | 4 | Elastic Deformation |
| 5 | 36 | 11.14 | 16 | 4.5 | Structural Failure of Materials |
| 6 | 35 | 5.57 | 14 | 1 | Structural Failure of Materials |
| 7 | 11 | 11.18 | 18 | 6.5 | Fracture of Materials |
| 8 | 12 | 13.08 | 18.5 | 9.5 | Fracture of Materials |



## General Comments

The GP3 paper had a lower average mark when compared to previous years (e.g. last year it was 63, vs 58 this year). Many of the answers did not address correctly the concepts or calculations set in the question. A common issue experienced by some students was to realize too late that key information was provided in the question's text. Lack of time did not seem to be an issue, since all questions were attempted, although some showing little insights.

Questions:

1) A relatively popular answer (78% students) on Plastic deformation of materials, consisting of relatively straight forward part a) dealing with a dislocation shear loop and subsequent sections to calculate forces and stresses on the dislocations. The majority of students got parts a) and b) correctly, while they struggled on parts c) and d), which required more complicated derivations.

2) A relatively popular answer (78% students) on Elastic deformation of materials dealing with a fibre composite and its behaviour under stress. The majority of students got over 50% of the marks, although many struggled with basic concepts needed for a correct answer. In particular, they did not appreciate how the stresses built in the fibre and the matrix differently.

3) A not very popular question (only chosen by 32% of the students) on Plasticity of Materials. The average mark was 50%. In this question, a maraging steel which had not been discussed in the course is introduced to the students which are asked to discuss the strengthening mechanisms. In Part a), number density and size measurements were required for precipitates shown in TEM micrographs. Many students failed to realized that having 2 types of precipitates with different compositions required these measurements to be done on the elemental maps (otherwise they cannot be distinguished). No student used the right formula for the 3D number density. Part b) required the use of the Friedel equation which, although correctly identified by many, was not used properly with many students not calculating the shear modulus correctly. Parts c) and d) provided more marks on average, with many students giving the right answers.

4) A popular question (chosen by 83% of the students) on Elastic deformation. The average mark was 65%. This question dealt with the strain experienced by a cylindrical void in aluminium. The students understood the radial nature of the strain and calculated correctly expressions its expressions, together with the stresses. In the final parts of the question (c and d), the total elastic strain and the work per length had to be calculated. These sections proved to be more challenging, with many students not knowing how to integrate when using cylindrical coordinates.

5) This was the most popular question, attempted by 88% of the students. The average mark was 55%. The question dealt with single-edge notched beam toughness tests, where the students had to calculate fracture toughness and the assumptions implied by Griffith's theory on the various materials tested. Kc calculations were not a problem for most students, but many failed to relate them to the suitability of Griffiths theory. In the final part, they were ask for methods to increase fracture strength or ductility for the various materials tested. This section was generally answered well, although many lacked depth.

6) This question, on General failure of materials, despite being the 2$^{nd}$ most popular, attracting 85% of the student, was also the one with the lowest average mark at 28%. The question dealt with a fibre oxide-oxide composite and the students had to discuss the mechanical properties of the fibres. Although the lectures point out the important of weak interfaces, very few students realize this was the case and scored low marks on sections a) and b). When calculating the mechanical properties, this was also generally ignored and, when marking, both examiners accepted the "not so correct" answers which assumed that both the matrix and the fibres contributed to the mechanical properties. Only one student got section d) right,

with mostly not realizing what was required. Section e) was generally answered correctly.

7) Question 7 was on Fracture of materials and the least popular one, attracting only 27% of the students. The average mark was 55%. The question covered Basquin's equation and how fatigue is studied analytically. Students found sections a) and b) relatively accessible but struggled on section c). Section d) was the most "text-book" one and got mostly good answers.

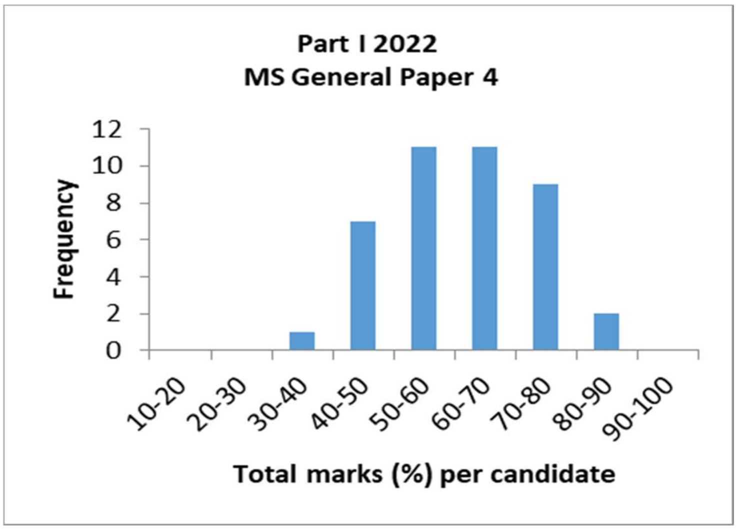
8) Question 8 was also on Fracture of materials and also not very popular (only 29% of the students chose it). The average mark was 65%. The question dealt with creep and its impact on materials properties. Part a) was "text-book" style and was answered correctly by most students. Part b) asked how creep is measured and many students failed to mention/describe experimental methods or tests. In part c) the students had to apply their knowledge to 3 different materials systems and they generally provided good answers. Part d) asked about creep's temperature dependence but many students failed to mention activation energies, which was the key.

## GP4 – STRUCTURE AND THERMODYNAMICS OF MATERIALS

**Examiner:** Prof. Keyna O'Reilly
**Candidates:** 41
**Mean mark:** 62
**Maximum mark:** 88
**Minimum mark:** 39

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 31 | 10.02 | 17.5 | 4.5 | Characterisation of Materials |
| 2 | 19 | 11.32 | 16.5 | 5 | Characterisation of Materials |
| 3 | 31 | 10.56 | 16 | 4.5 | Characterisation of Materials |
| 4 | 22 | 11.66 | 18.5 | 3.5 | SMTP |
| 5 | 25 | 9.56 | 16.5 | 5.5 | SMTP |
| 6 | 26 | 12.69 | 19.5 | 6 | Phase Transformations |
| 7 | 30 | 12.32 | 18.5 | 3.5 | Phase Transformations |
| 8 | 21 | 10.67 | 18 | 2 | Phase Transformations |



## General Comments

This was the first year with the new structure of GP4, so no direct comparison is made with the previous year. The questions required understanding and application of the course content, and in several questions the candidates were given experimental data to analyse. This was generally rather poorly done, as candidates often ignored the data and just gave an explanation of a general situation i.e. they did not tailor their answers to relate to what was actually being shown in the data. As a result, the overall marks for the paper were lower than expected.

Characterisation of Materials (questions 1 to 3) was the most popular topic, with question 2 being slightly less popular than the other two questions. Statistical Mechanics and Thermal Properties of Materials was the least popular topic and had the lowest average marks. Phase Transformations was of intermediate popularity but had the highest average marks overall.

Questions:

1) (a)(i) The most frequent mistake made by candidates answering this question was to name a characterisation technique which was not capable of resolving precipitates < 5nm in diameter. In addition, explanations of why each technique would be suitable were often rather vague and/or confused and there was often little if any comment on potential issues. Very few candidates used the data presented in the question to justify their choices.

   (a)(ii) Errors in identifying suitable techniques in (a)(i) were carried over into (a)(ii).

   (a)(iii) Few candidates managed to note both that the interaction volume is too big and (using the additional data provided) that there would not be sufficient contrast between the matrix and the precipitates.

   (b) Virtually nobody could identify why carbon would be an issue. Phosphorous segregation was better explained.

2) (a)(i) This was generally answered well.

   (a)(ii) Not all candidates noted all of the additional reflections which became allowed or that they would be weaker. Some explanations of why they were weaker (i.e. that the intensity was being dispersed into a larger number of spots) were incorrect.

   (a)(iii) Generally lacking explanation.

   (b)(i) Most candidates could correctly identify a suitable direction.

   (b)(ii) Virtually nobody mentioned the concept of “channelling”.

   (b)(iii) Most candidates could correctly name a suitable technique but many did not correctly use the data provided to explain which of the transitions would be detectable.

3) (a) The mechanism was generally well explained though some candidates did not note that an electric field is still required but that it is just slightly less than that needed to effect field evaporation. Several candidates incorrectly described how the mass-to-charge ratio was determined.

   (b) Few candidates described the two processes occurring which led to a steady-state shape. Most said that the laser preferentially heated the right-hand side of the sample and that this reduced the electric field required for field evaporation of the ions hence more ions are evaporated. Few realised that the resultant larger radius of curvature reduced the local electric field, such that a steady state was obtained.

Most candidates realised that the lines representing the projection of the ions would be closer together on one side of the tip, but not all correctly identified which side or correctly explained why this occurred.

(c) This was the most difficult part of the question and was marked generously. Most candidates made some good progress, but not all realised that some of the mass-to-charge ratios observed has contributions from more than one type of B ion, and these needed to be deconvoluted.

4) (a) Many candidates noted that the particle nature of the heat carriers allowed kinetic theory to be used.

(b) Most candidates noted the low probability of electron-electron scattering, but many did not give an accurate explanation in terms of necessary energy proximity to the Fermi energy.

(c) These phenomena were generally well described. The most common omission was to leave out noting that the heat capacity reduced at lower temperatures and hence the thermal conductivity reduces.

(d)(i) The reduced scattering time at high temperatures was widely noted, but the reduced heat capacity at low temperatures less commonly noted.

(d)(ii) Few candidates noted that low temperatures were needed to give sufficiently long scattering lengths such that scattering at the surfaces became significant.

(d)(iii) Many candidates were able to identify the key points explaining this phenomenon.

5) (a)(i) A straightforward section that was accurately answered by most candidates.

(a)(ii) Generally accurately answered, though there was a risk that candidates could reverse engineer this derivation.

(a)(iii) Most candidates could complete the necessary differentiation to complete this derivation.

(b) This section was generally poorly attempted. Most candidates did not take note that only 5 electrons were present in the system and instead attempted to use ideas around the heat capacity of a many-electron free electron gas.

(c) Most candidates realised that the magnetic field led to splitting of the levels, but fewer noted that the impact on heat capacity would only occur for kT near the energy of the splitting.

6) (a) Most candidates made a reasonable attempt at describing the equilibrium solidification process and the modification to composition under more realistic conditions. Fewer adequately referred to the equation provided to discuss the competing thermodynamic and kinetic factors.

(b) Virtually all candidates correctly identified the invariant reactions, but not all could correctly relate the phases to the micrographs. Most failed to realise that the faster growth (reduced time for diffusion) led to Bridgman-type growth, resulting in an enrichment of solute (Ti) in the primary dendrites and so leading to a reduced amount of eutectic.

7) (a) Several comprehensive answers, though some candidates neglected to describe the actual stages of the experimental investigation (i.e. what physically needed to be done) and only described the subsequent analysis of the data.

(b) Most candidates had a reasonable attempt at this question, but virtually nobody actually referred to the data provided.

(c) Most candidates could adequately describe this famous conundrum.

(d) Few candidates commented on both the size effect of the permeant and the effect of the rigidity/crystallinity of the polymer.

8) (a) Most candidates just described the general processes occurring in the nucleation and growth of precipitates and did not refer at all to the data they were asked to explain.

(b)(i) Precipitate free zones are most commonly observed adjacent to grain boundaries (as diffusion rates are faster), but some credit was also given to their existence around precipitates.

(b)(ii) Generally well answered.

(b)(iii) Not all candidates recognised that the metallisation track was a polycrystalline thin film and experienced rapid grain boundary diffusion due to the high current density.

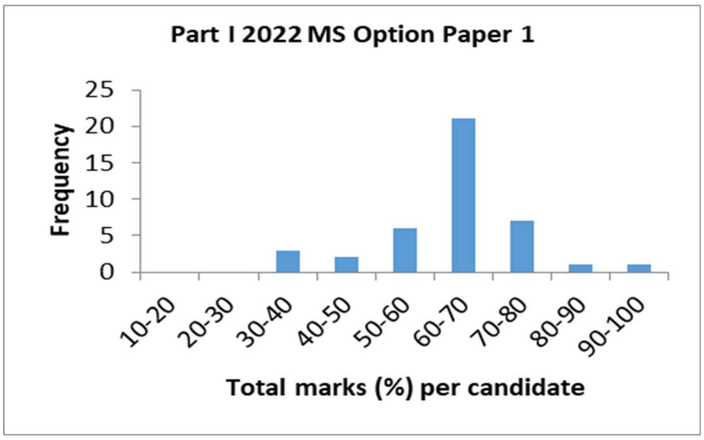
(b)(iv) Few candidates correctly identified this as an example of bulge nucleation or correctly explained the implication of there being hard particles.

## Materials Options Paper 1

**Examiner:** Prof. Pete Nellist / Prof. Jason Smith
**Candidates:** 41
**Mean mark:** 66
**Maximum mark:** 93
**Minimum mark:** 36

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 22 | 15.20 | 24 | 10 | Prediction of Materials Properties |
| 2 | 18 | 15.86 | 24 | 11 | Prediction of Materials Properties |
| 3 | 23 | 15.07 | 22 | 5.5 | Engineering Ceramics: Synthesis and |
| 4 | 15 | 14.33 | 24.5 | 5.5 | Engineering Ceramics: Synthesis and |
| 5 | 2 | 11.75 | 19 | 4.5 | Magnetic & Superconducting Materials |
| 6 | 19 | 15.66 | 21.5 | 2.5 | Magnetic & Superconducting Materials |
| 7 | 11 | 12.95 | 20.5 | 6 | Materials and Devices for Optics and |
| 8 | 19 | 14.39 | 20 | 4 | Materials and Devices for Optics and |
| 9 | 11 | 12.14 | 20 | 5 | Advanced Manufacture with Metals & Alloys: Processing, Joining and Shaping |
| 10 | 20 | 17.85 | 23.5 | 12 | Advanced Manufacture with Metals & Alloys: Processing, Joining and Shaping |



Prior to scaling, this paper had a relatively low mean. As can be seen from the marks breakdown, almost all the questions produced a very wide range of marks. There were some very good answers, indicating that the questions were overall of an appropriate standard, but some candidates struggled to produce much of value for some questions leading to some very low marks that lowered the mean. In light of the marks, the examiners re-reviewed specific scripts across a range of marks and were content with the applied scaling.

Questions:

1) A popular question about many electron atoms and Hartree theory. Parts a-c concerned the basics of the theoretical approach and were generally well done. Part d required calculation of the Hartree energy for the neutral helium atom. Aspects of this were done well but many students did not construct the volume integral correctly. Parts e and f required students to think about approximations made in Hartree theory and the computational requirements for calculations on larger atoms. Most students were able to answer these parts reasonably well.

2) A question on density functional theory. Parts a-c involved extracting information from a graphical dataset and were generally done very well. Part d explored deeper understanding by asking what would happen to the graph if a more accurate functional were used, and elicited a range of answers. Part e tested students' knowledge of how spin is introduced to the calculations and most students showed a good grasp of this. A calculation in part f required good understanding and the analysis of a density of states graph in part g was done reasonably well by most students.

3) This question required the use of a supplied graphical aid, with the students requested to indicate their method using schematics sketched in their scripts. This worked well, and the examiners were able to discern the level of understanding. Parts (a) and (b) were generally done well. In part (c)(ii), many candidates were unable to use the information provided to estimate an initial flaw size. Part (d) showed variable understanding of this area.

4) This was a testing question that produced a wide range of marks including some very strong answers. The question was well-graded and there was no one particular section that caused greater problems for candidates than others.

5) A question on magnetism attracting only 2 attempts. The question covered three topics – the effect of crystal symmetry on magnetic structure, spin-lattice relaxation, and commutation of spin operators. One student did very well, showing a good grasp of each of these topics and the other very poorly picking up only a few marks.

6) A popular question on flux pinning in type II superconductors which returned a good average mark. The question concerned different types of pinning as they relate to microstructural defects in different materials. Part a for the first 12 marks was essay-style, while part b required reasoned analysis of data to identify the pinning mechanism, and part c explored the limitations of a physical model. All sections were done reasonably well with students showing varying degrees of knowledge and understanding.

7) Candidates found this question challenging, with a relatively low mean, but a highest mark above 20 was recorded. In part (a), most candidates were able to describe the roles of the various components, but struggled more to identify suitable materials, especially for the functional part of the system. The was significant variability in the ability of candidates to make use of the information provided in part (b). Most candidate were able to identify the use of phase modulation for part (c), but found coming up with a specific configuration to be challenging.

8) This question covered familiar content about solar cells, with the additional complication of considering series and shunt resistances. Most students were able to produce a reasonable estimate of their effect on the I-V characteristics. Estimating the improvement due to reductions in the resistances was a little more challenging for students. The understanding of the requirement of current matching in the tandem cell was a bit more patchy leading to many inaccurate answers. Similarly, the necessary order of the materials for the three tandem cell was missed by many candidates.

9) A question on hot tearing attempted by several candidates but attracting a fairly low average mark. Students generally showed a good understanding of the hot tearing mechanism and how it relates to mushy zone morphology (parts a and b), but were weaker on segregation phenomena (part c) and on the effect of undercooling on morphology and on nucleation-free zones (part d)

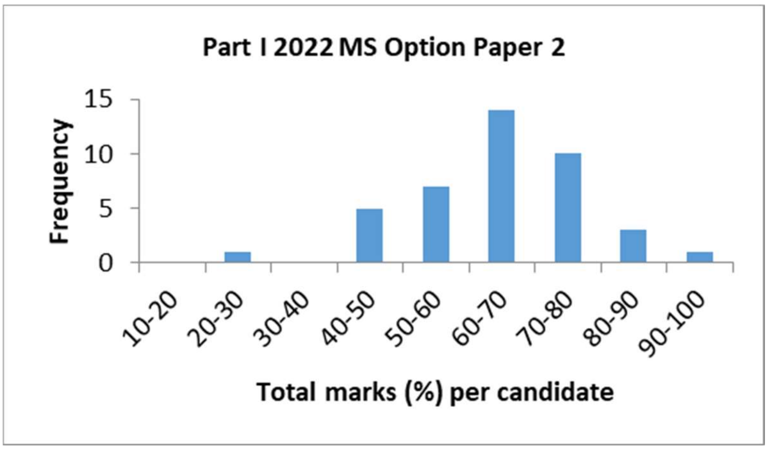
10) This question was generally answered quite strongly with candidates able to address the requirements in parts (a) and (b) quite well. The most common error was including two closely related welding techniques that could not be regarded as being distinct.

## Materials Options Paper 2

**Examiner:** Prof. Simon Benjamin / Prof. Sergio Lozano-perez
**Candidates:** 41
**Mean mark:** 66.5
**Maximum mark:** 92
**Minimum mark:** 27

Detailed comments on the paper are as follows:

| Question | No of Answers | Average Mark | Highest Mark | Lowest Mark | Topic |
|---|---|---|---|---|---|
| 1 | 14 | 13.79 | 18.5 | 9 | Materials for Nuclear Systems |
| 2 | 9 | 16.33 | 22 | 9 | Materials for Nuclear Systems |
| 3 | 13 | 14.56 | 23.5 | 3 | Devices |
| 4 | 10 | 15.00 | 23 | 6 | Devices |
| 5 | 28 | 16.09 | 21.5 | 8.5 | Biomaterials and Natural Materials |
| 6 | 14 | 12.89 | 18 | 5 | Biomaterials and Natural Materials |
| 7 | 27 | 15.87 | 23.5 | 9 | Advanced Polymers |
| 8 | 19 | 14.76 | 22 | 2.5 | Advanced Polymers |
| 9 | 14 | 15.46 | 22.5 | 6 | Enabling Nanotechnology |
| 10 | 12 | 18.11 | 23.5 | 12.5 | Enabling Nanotechnology |



**General Comments**

Overall the performance on the paper was quite satisfactory. There was a good spread of take up over the questions, with the anticipated peaks in the popular Biomaterials and in Advanced Polymers topics. The spread in performance was consistent with a typical normal distribution.

Questions:

1) This question on Materials for Nuclear systems was chosen by 34% of the students, with an average mark of 55%. It dealt with radiation damage in nuclear reactor materials. Part a i) was “text-book” style and the students did generally well. In part a ii), they had to calculate the threshold displacement energy for Pd. Although the mathematical approach as generally correct, very few reached the correct answer. Part b required the description of breeding nuclear fuels in fusion and fission reactors. The students provided acceptable answers in most cases. In part c, the effect of flow rate in BWRs had to be explained. This section had mixed results with some very good answers and some completely wrong.

2) Question 2 was also on Materials for nuclear systems and was chosen by 22% of the students with an average mark of 65%. The topic of this question was the role composition (Cr content) on corrosion resistance under PWR conditions. The students were provided with a list of properties of two commonly used Ni alloys and had to justify the observed behaviour in service. The answers were generally ok, demonstrating that the key concepts had been grasped. However, many failed to link the observations with the SCC models introduced in the lectures.

3) Question 3 was on Devices and attracted 32% of the students, with an average mark of 58%. The question dealt with Fe-F electrodes for Li batteries. In part a), the students had to explain the various chemical reactions involved and did it generally well. In part b), a label explaining the compound had to be explained, but most failed to recognize the various parts. Parts c, d and e covered the electrical properties of the battery. The students often used the wrong parameters for the calculations and only a few got the numerical answer right. Part f required explaining the advantages and disadvantages of Fe-F cathodes and was generally well answered. Part g asked for challenges in scaling up this material and was also answered correctly in most cases. Part h asked for a comparison between V hysteresis in two materials with students missing some of the key differences.

4) Question 4 was on Devices and was selected by 24% of the students. The average mark was 64%. The question covered ceramic materials and their application as dielectric resonators and a final part on Pb-Zr-titanates. It was generally answered well, with most students identifying which materials would be more suitable for the specified applications. They struggled more with parts c and h. On part h, many failed to get the key concepts right.

5) Question 5 was on Biomaterials and was attempted by 68% of the students, being the most popular choice. The average mark was 64%. The students exhibited a general good knowledge of the topic, although the majority struggled with section b ii) and iii). Many of the sections were text-book style with some further reasoning expected.

6) Question 6 was also on Biomaterials and chosen by 34% of the students with an average mark of 51%. It covered several topics, including phospholipids assemblies (a), hydrogels (b) and internal fixators (c). Part a was generally answered well, although many struggled with section iii). Part b did not go very well, with most students struggling to get the right exponents in sections ii) and iii). Part c resulted in high marks for most of the students, who could describe successfully how each of 3 different fixator materials would perform in the short, medium and long term.

7) This was the second most popular question on the paper. Overall the performance of the students was satisfactory. Below are remarks on a part-by-part basis; these comments were provided by question setter and marker Hazel Assender, and are agreed by SCB.
(a): Straightforward question. Most candidates got heat capacity change and basic concept of Tg. A few candidates had a poor understanding of what Tg is.
(b): Key point is free volume/increased mobility at the chain ends. Some candidates talked about 'more entanglements', but entanglement density is not Mw dependent.
(c): A good number of strong answers.
(d): Poorly answered often from misinterpreting the question to compare what would happen as the Tg of the polymer differed, or what mechanism would be different at the free surface or in the bulk, rather than considering the Tg as measured at the free surface and the fracture surface.
(e): i) Candidates often described partially miscible/immiscible systems (not needed) and often did not give the reason for segregation (surface energy). The answer needed to be related back to Tg. ii) many candidates were able to describe that there is less entanglement at the surface and link this to Tg. Typically weaker or did not comment on the comparison of the free and fracture surface.

8) The less popular of the two Polymers questions, which students evidentially judged was the harder — and indeed the performance on this question is appreciably worse. Below are remarks on a part-by-part basis; these comments were provided by question setter and marker Hazel Assender, and are agreed by SCB.
(a): Some candidates spent time defining what binodal and spinodal decomposition was. Emphasis should be on the light scattering experiments, and marks were given for describing the appropriate rate of heating in each of the binodal and spinodal measurements. Several candidates mentioned neutron scattering rather than light scattering methods.
(b) A well answered section with some weaknesses on defining what the 'scattering cross section' means.
(c) In some cases candidates incorrectly suggested a physical or chemical characteristic each term measured rather than what the parameter defined.
(d) Candidates often got some credit for mentioning measurement of structure, but in many cases would incorrectly discuss incoherent and coherent measurements.
(e) A relatively strong section. Many candidates were able to give a good diagram of the experimental geometry, but in some cases were weaker on changing the sample – detector distance.
(f) Most candidates got some kind of Bragg-like relationship, although the exact form was often incorrect leading to an incorrect value. The local structure section was weaker with candidates often still considering large length scales such as Rg.

9) This is the first of two quite well-answered Nanotechnology questions.
The first part required explanation of how liquid crystal displays work, and was generally well-answered. The second part concerned creating a process flow for the fabrication of a device using a (fictional) material — as is often the case, the quality of the process flow proposals varied widely between students as this is a good general test of putting understanding into action. The third part of the question explored nanomechanical force sensors — this was less well answered on the whole with several students failing to remember the background material. The final two, short, parts of the question concerned wet etching versus dry, and Archard's law, and these were well-answered.

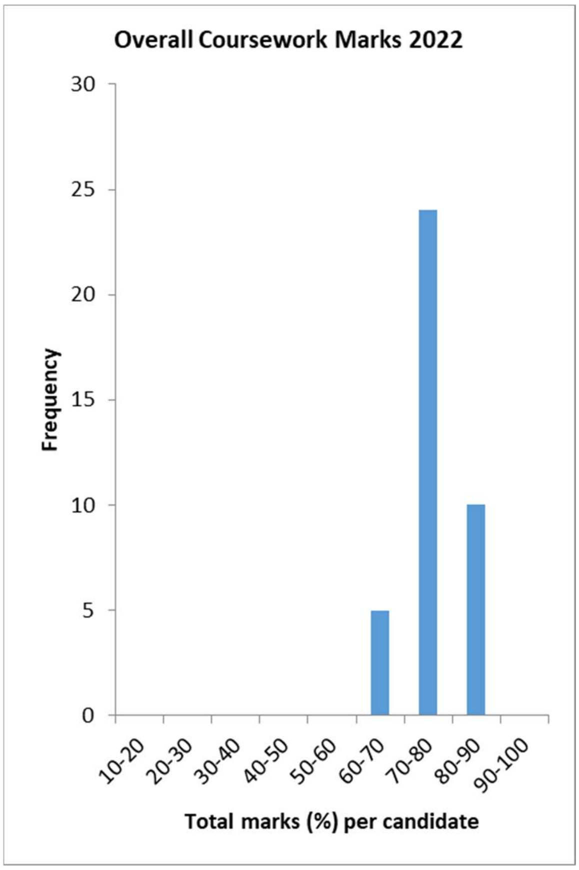
10) The second of the two Nanotechnology questions. Well answered on the whole.
The first several parts of the question explored the physics of nanostructures and was quite well-answered except that a surprising number of students failed to identify the primarily forms of energy involved in polaritons and plasmons.
The middle part of the question regarding Knudsen numbers was well answered, suggesting that the students understood this concept (despite their being a typo 'Knusden' in the paper).
The parts of (e) and (f) that needed a narrative about the relative merits of different fabrication methods were quite well answered. The final section requiring a numerical calculation was tackled successfully by the majority of the students who got that far.

## COURSEWORK

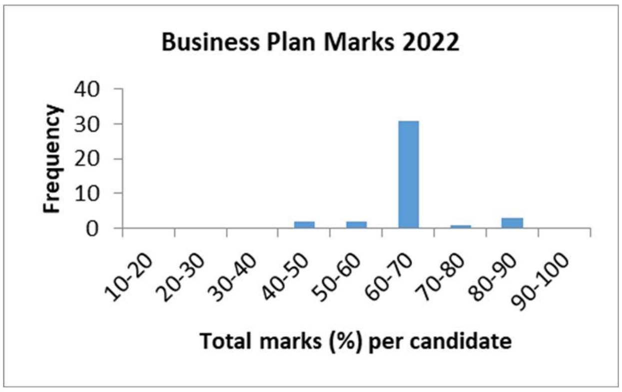
A maximum of 200 marks are available for Part I coursework which comprises:

- Y2 Entrepreneurship Module: Business Plan – 20 marks
- Y2 Industrial Visit Reports – 10 marks
- Y2 Practical Lab Reports – 60 marks
- Y3 Introduction to Modelling in Materials – 30 marks
- Y3 Option Modules: Advanced Characterisation/Atomistic Modelling– 30 marks
- Y3 Team Design Projects – 50 marks

**Overall coursework** marks were good, and in the range expected for what is generally continuously assessed work.



The **Business Plan** marks (average 66.17%) were in a relatively narrow range.




**2022 Report on Business Plans (worth 20 marks)**

The candidates in this module were arranged into 6 separate teams, with each team submitting a single business plan. The assessment criteria are based on 8 different sections of the business plan which are weighted according to their importance for the plan.

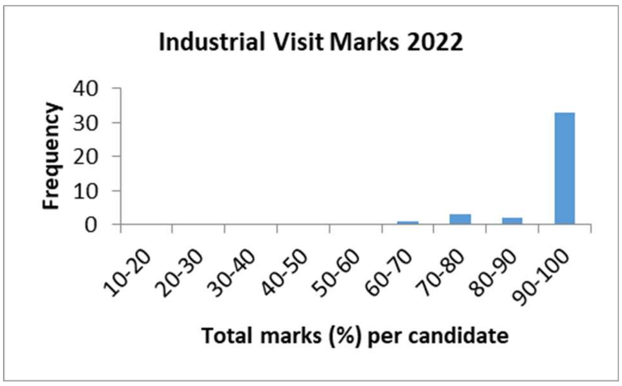
In 20/21 the plans were all tightly clustered in overall marks. However, drilling down into the details, it is clear that different plans had strengths and weaknesses in different areas. In general, most teams had trouble in finding the right level of technical detail necessary to inspire confidence in the technology. The evaluation of the market was also challenging. However, all teams did very well on most sections, although very few did exceptionally well across all sections.

Almost all teams were weak on the section on “The Markets”. This is intrinsically a challenging section. Yet most teams could have used some analytical thinking to work out an addressable market from the overall market, based on justifiable assumptions. Working as a team they should be able to help one another identify issues and collectively be able to develop responses to them. A good market plan is borne via frank discussions and developing a strong rationale for why a particular market is worth addressing – and teams that work together would be able to develop this more robustly.

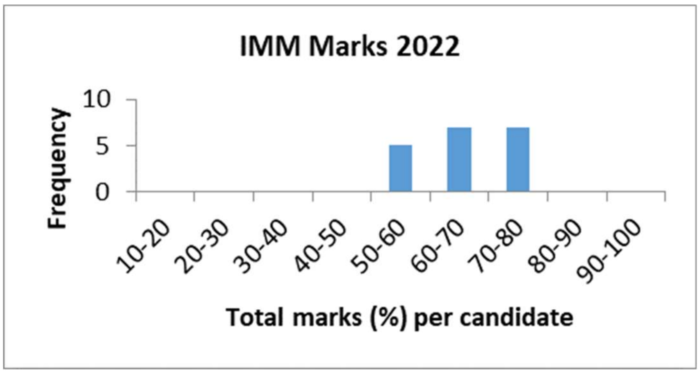
While no single team got an overall first, the weaknesses were all different across different teams, suggesting that the course was overall balanced and no obvious deficiencies in a single area. It is also clear that the strengths were also distributed well, which resulted in a strong showing across all teams.

Prof Harish Bhaskaran
11/05/2021

The **Industrial Visits** mark (average 96.15%) are near-perfect, as full marks can be obtained by producing a good report; the small number of reports that are only satisfactory or late are strongly penalised.



Marks for the compulsory **Introduction to Modelling in Materials** module (average 64.83%) ranged throughout the lower 2nd to 1st class boundaries.



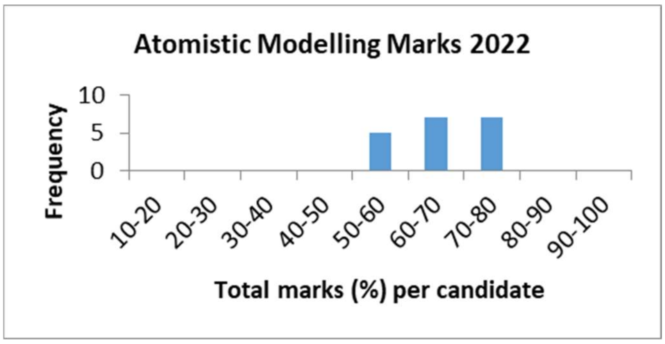

**Report on the Introduction to Modelling for Materials Science module**
This was the second year of running the course in its new format. It was taught remotely again: this was due to the fact that Prof Drautz is based in Bochum and at time of planning, the uncertainty in international travel.
We used the same setup as 2020-21 with the addition of recorded walkthrough videos for each practical. This reduced the volume of support questions during the practical sessions. We also believe these are a useful resource when the students complete their projects.

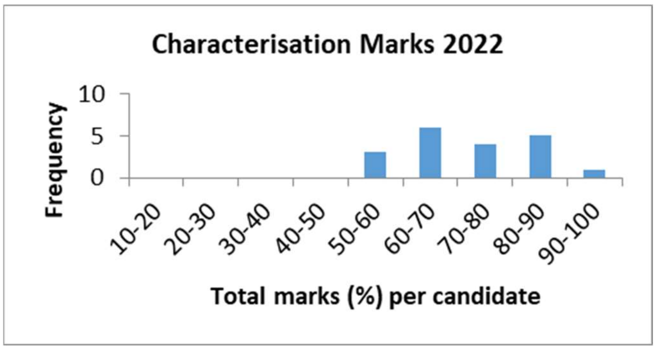
There were no issues with any of the software packages or computer systems this year. All students completed the practical sessions in the first week.

The projects were of a similar standard to last year. The best reports showed a deep grasp of the topics and good insight. Weaker project struggled with presenting data in a clear format. For the second year the Finite element project was selected by relatively few candidates – although those who took it scored highly. Next year we will switch to the online version of Matlab – so that there is a consistent browser based platform for all projects. I will also be a relief to return to face-to-face classes – and I would prefer to not draw major conclusions with regard to project choice, until after next year.

Prof. Jonathan Yates- June 2022

The option modules, **Atomistic Modelling** (average 66.10%) and **Advanced Characterisation** (average 70.45%), exhibit a full range from lower 2nd class to good 1st class marks. The work done was reviewed independently by the Examiners.






**Report on Atomistic Modelling Option Module**

Although the Atomistic Modelling module was introduced in 2020-2021, this academic year (2021-2022) was the first time the course was run in-person. 22 students (+1 visitor) took the course. The first week consisted of morning and afternoon sessions, starting with a 30-40 minute lecture followed by a hands-on practical session, all located in the teaching room in the MML and supervised by JRY or CEP. The number of students unable to attend due to COVID reasons was two at the start of the week, and this increased to six over the course duration.

These students participated remotely, watching the lectures pre-recorded for 2020-2021, following the practical sessions at their own pace and given help via email and video call. In the second week, students were assigned pseudo-randomly (balanced across colleges) one out of three possible projects. The teaching room remained available as a workspace in this time. Support was given via email.

Each student was given a user account on one of three multi-core Linux servers based in the Department. The students were instructed how to install and use freely available software (e.g. MobaXterm) to access these servers from the various operating systems installed on their own personal computers. Two students were loaned laptops from the department. The modelling calculations were performed using CASTEP, with additional postprocessing and analysis performed using the OptaDOS and SUMO packages. All of these packages were pre-installed on the servers and the students instructed how to run software serially and in parallel. There were no significant technical issues.

The written reports were of a good standard overall, showing competence in running the calculations and describing the results. The reports which scored most highly did not necessarily contain the largest amount of raw data, but instead formed a coherent narrative balancing the results, analysis and discussion.

Dr C.E. Patrick
2021-22

**Report on the Characterisation of Materials Option Module**
This module is intended as a hands-on learning experience for students to further their theoretical understanding of materials characterisation techniques and to develop skills in its practical implementation in the laboratory across a range of instruments. It is also intended to develop skills and experience in independent and unguided research leading into their Part II year.

After COVID restrictions in 2021 prevented any hands-on experiments, in 2022 the module welcomed students back into the laboratory. The return to hands-on work was also accompanied by the biggest ever class size of 23 students, which is approximately double the numbers that have signed up for this module in recent years. This much larger class size, combined with the tentative return to in person teaching after the easing of COVID Omicron restrictions, provided significant organisational challenges, balancing the need to keep students safe while also maximising their training on, and timely access to, the assorted characterisation techniques that underpin the module. It also required significant contingency planning.

At this point the module organisers must thank the Teaching Laboratory Manager Diana Passmore for her invaluable contributions organising the course and facilitating the increased numbers of students in the laboratory. Organisers would also like to acknowledge Dr Benjamin Jenkins for his significant input to the planning of the course and leadership in the day-to-day running of the module. Finally the organisers also thanks the team of dedicated Junior Demonstrators who facilitated the training and supported access to the microscopes. Dr Megan Carter, Martin Meier, Laura Wheatley and Bradley Young, went above and beyond to guide, support and solve problems for the students throughout the duration of their time in the lab.

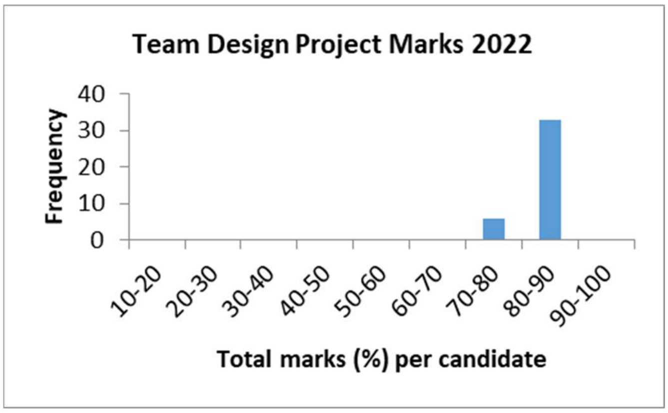
The re-structuring of the 2nd Year Course Structural and Compositional Characterisation of Materials led to significant overlap with the lectures presented in 3rd year Advanced Characterisation of Materials module, with Scanning Probe Microscopy, NanoSIMS and Atom Probe Tomography now being covered in the second year course. This led to a restructuring of the lectures presented in the first with the week, with the aforementioned topics removed from the line-up and replaced with new lectures on: Focussed Ion Beam techniques (Dr Gareth Hughes) , an overview of activities undertaken by the Oxford Materials Characterisation Service ( Dr Colin Johnston ) and a series of three shorter talks on research undertaken at synchrotron facilities using different X-ray techniques (Dr Enzo Liotti, Prof Rob Weatherup and Prof James Marrow) .

In the laboratory students had access to optical microscopy, SEM, EDX, XRD, micro indentation and an optical emission spectrometer. Given the time constraints, informal feedback indicated that for the most parts students had sufficient access to instruments to complete their reports. Junior Demonstrators reported that the limited opportunity for hands on experiments in the previous 12 months had affected the confidence of some students in the laboratory. However, these students were well supported and overall the quality of characterisation results presented in the reports was very good.

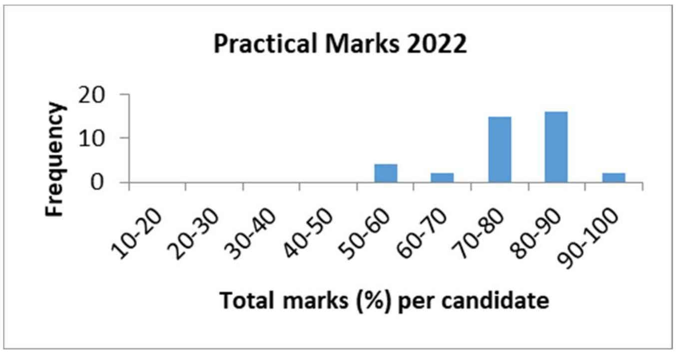
The average grade was for the marked reports was approximately 69, which is in line with previous years. However, there were specific aspects of the reports that assessors felt could be improved. One of the most significant concerns was an inability to identify a compelling narrative motivating their research. Many of the reports either did not present a novel and cohesive motivation for why the results and the interpretation of their results was interesting from a materials science perspective, or adopted an overly simplistic theme, for example, simply confirming some well-known phenomenon previously presented in lecture notes or a text book. This issue was most notable in the *Introduction Section and Summary and Conclusions* sections*,* respectively. The assessors also note some basic issues around clarity, for example, providing enough description in the *Results Section* in the main text such that the reader can immediately understand what is the nature of the image being presented, or drawing attention to any specific aspect of the result that will be further interpreted in the *Discussion Section*. There was also often limited imagination shown in the Future Work Section, with many students simply stating what they would do with the same techniques if they had a longer time to undertake their experiments, rather than discussing the new information that might be gleaned from other complementary and/or more advanced microscopy techniques that they were introduced to in the lectures (and also in the 2nd year characterisation course).

Prof M.P. Moody
Trinity 2022

The **Team Design Project** marks (average 82.88%) show a moderate narrow range, close to the upper second/first class level, which is reasonable given the sustained effort in a group task.




The marks for **Practical Classes** (average 77.34%) have been reviewed by the Practical Class Organiser, who concluded that, although the range of marks for an individual practical varied from practical to practical, all students have been treated equally.




**Report from the Practical Courses Organiser**
**Materials Science 2nd year Practical Labs in 2020/21**

I have reviewed the marks from the 2nd year Practicals from 2020-21. This academic year was substantially affected by the Covid-related measures in place, particularly those referring to social distancing and the restrictions imposed in the labs capacity. For that reason, the following practicals were offered online only: 2P2, 2P3, 2P4, 2P5, 2P6, 2P7, 2P8, 2P9, 2P11. Only the following practicals (selected because of their relevance in the course) happened “physically” in the lab: 2P1, 2P10, 2P12. There is quite a wide range of overall average marks, assuming the standard penalties are applied, ranging from 51 to 90%, with an average and median of 77%. These general results are in line with past years records, but the average is higher (e.g. it was 66% the previous year). The range of marks for an individual practicals vary from practical to practical. They were all within 20% of each other. The lab notebook marks were all above 2, averaging 2.4, while the average on the reports was 10.

**Gender:** I have assessed the marks for gender imbalance by looking to see who has received the highest and lowest marks for each practical. While last year, female students exhibited 1% higher marks than their male counterparts on average, this year their marks are similar within 4%.

**Late penalties**
We are proposing late penalties to the following reports:

- 2P3 Extrusion, 4 late candidates:

  - [redacted]

- 2P12
  - [redacted]

  6 extensions granted for this practical all by SLP (or PJM in absence).

**Special cases:**

- [redacted]

- [redacted]

- There are a number of students who were late submitting (2P5 and 2P12) but were able to present either medical certificates explaining the reasons for the delay. No penalties are to be awarded in these circumstances, in line with the rules outlined in the handbook.
- There are three candidates ([redacted]) who have suspended since completing practical work. They have been included in the statistics so that they can be included in the report alongside the relevant student cohort.

**Plagiarism:** No cases of plagiarism were reported by the senior demonstrators.

Practical Courses Organiser – Sergio Lozano-Perez
June 2022

# 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. 1 candidate was awarded a BA(Hons) degree for which the examination required the candidate to submit an extended essay and then given a classification on the basis of their performance across Part I and Part II.

| Class | Number | | | | Percentage (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2021/22 | 2020/21 | 2019/20 | 2018/19 | 2021/22 | 2020/21 | 2019/20 | 2018/19 |
| I | 15 | 19 | 19 | 11 | 36.6 | 65.5 | 57.6 | 34.4 |
| II.I | 22* | 9 | 12 | 17 | 53.7 | 31.0 | 36.4 | 53.1 |
| II.II | 4 | 1 | 2 | 2 | 9.8 | 3.4 | 6.0 | 6.0 |
| III | - | - | - | 1 | 0 | 0 | 0 | 3.0 |
| Pass | - | - | - | - | 0 | 0 | 0 | 0 |
| Fail | - | - | - | - | 0 | 0 | 0 | 0 |
| Total | 41* | 29 | 33 | 32 | - | - | - | - |

* 1 candidate completed with a BA (hons)

The examiners note that a significantly higher proportion of Class 1 degrees were awarded in 2019/20 and 2020/21 than in 2018/19, and that in 2021/22 the distribution has returned closer to pre-pandemic levels.

(2) **The use of vivas**
The mark for the Part II is for the thesis or extended essay alone. All candidates, except the BA hons candidate, were given a viva solely to clarify points of detail and to ensure that the thesis presented had been prepared by the candidate being examined. The discussion in vivas was led by the Internal Examiners or Assessor who had read the thesis fully, and one of the External Examiners also had the opportunity to ask questions.

(3) **Marking of theses**
All theses and extended essay were double blind marked by two Internal Examiners or an Internal Examiner and Assessor, and were inspected by one External Examiner. Due to the modest 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 the Examiners/Assessor who were present. The two internal Examiners/Assessors who read the thesis provided the greatest input to the decision making process.

### B. NEW EXAMINING METHODS AND PROCEDURES

New methodology had been implemented in 2020 to implement changes that the Department had resolved to introduce prior to the Covid pandemic, and those that were in response to the pandemic. All of these procedures were used again this year EXCEPT the use of a “safety net”. The same report form template was completed by each session Chair as was implemented in 2020.

All vivas were carried out with Examiners, Assessors and Candidates present in person, with the exception of one Assessor attending online, and one case where the candidate was unable to attend and the raw marks for the thesis were reconciled by the Examiners without a viva.

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

The Examiners would like to highlight the challenge presented to marking of Part II theses where a large number of extensions are granted and theses are received by the Examiners a few days before the scheduled vivas. A change in procedure for granting extensions that reduces the burden on Examiners in this respect should be considered.

### D. EXAMINATION CONVENTIONS

The current year's Conventions were put on the Departmental website and sent electronically to all candidates. The Examination Conventions were assessed by the Board of Examiners and the Department's Academic Committee.

## Part II

### A. GENERAL COMMENTS ON THE EXAMINATION

Of the 41 candidates whose results were ratified by the examiners all were awarded Honours. 40 candidates completed a Part II project for which 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 30 minute viva, during which they were asked detailed questions on their thesis and research work. 1 candidate was awarded a BA(Hons) for which the examination required the candidate to submit an extended essay.

The theses were mostly of a high quality, and the candidates were able to explain their work well in the vivas. The marks for the Part II examination ranged from 55% to 85% with an overall mean mark just below the 2:1/1st class boundary. The External Examiners played an important role in the discussions that led to the decisions on the final marks for the candidates and the Chair would like to express his thanks to both of them for their hard work in inspecting the substantial number of Part II theses and contributing to the vivas.

Six Assessors were appointed in addition to the six examiners. This was one more Assessor than last year because there were more candidates this year (41 versus 29 last year). This helped to alleviate the time constraints imposed on Examiners and Assessors due to eight candidates being granted extensions to their projects by the Proctors. In five of these cases the maximum extension possible was granted i.e. noon on the day before the marks were due to be submitted by the Examiners/Assessor to the Administrative team.

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

The mean mark for theses written by female Part II candidates was 70.7% while the mean mark for theses written by male candidates was 67.6%. The standard error in these figures was 1.8% and 1.9% respectively.

There were no applications for consideration for specific learning difficulties made for the Part II component of the exam process this year (although a Form 2D alerting the examiners to an SpLD of some sort was included where appropriate).

| | Overall mark | | Part II Project | | Part I Mark | |
|---|---|---|---|---|---|---|
| mark (%) | Male | Female | Male | Female | Male | Female |
| 30-40 | - | - | - | - | - | - |
| 40–50 | - | - | - | - | - | - |
| 50–60 | 2 | 2 | 5 | - | 3 | 4 |
| 60–70 | 15 | 9 | 11 | 12 | 12 | 7 |
| 70–80 | 5 | 5 | 6 | 2 | 8 | 5 |
| 80–90 | 2 | - | 2 | 2 | 1 | - |
| 90-100 | - | - | - | - | - | - |
| Totals | 24 | 16 | 24 | 16 | 24 | 16 |

**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 (2021) and Part II for these candidates are given above.
There was one student who completed a BA (hons) and they took the same examinations and produced an extended essay.

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

Comments on the overall candidates' performance in the Part II coursework are attached.

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

**Mitigating Circumstance: Notices to Examiners.**

19 applications for consideration of Mitigating Circumstances: Notices to Examiners were submitted. The examiners considered the cases carefully and a fair course of action was agreed. This was documented in MCE reports. One classification were changed (2:1 up-lifted to 1st) on the basis of MCE notices and one late penalty was waived

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

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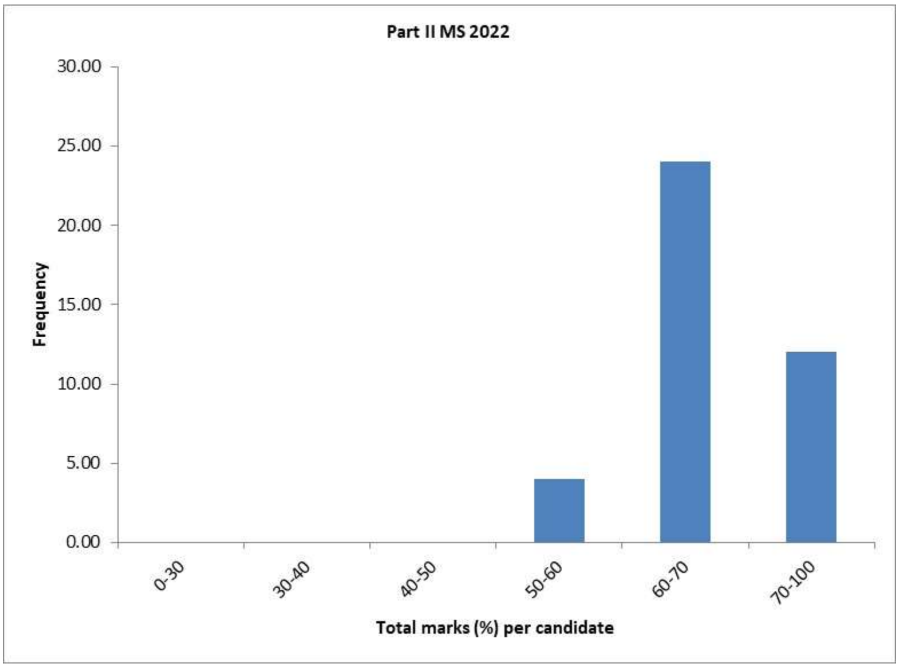
### F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

| | |
|---|---|
| Prof. S. Lozano-perez | Prof. K.A.Q. O'Reilly |
| Prof. S.C Benjamin | Prof. P.D. Nellist |
| Prof. J.M. Smith(Chair) | Prof. T.J. Marrow |
| Prof. G. Williams (external) | Prof. P.D. Haynes (external) |

## Report on Part II Projects

**Candidates:** **40**
**Mean mark:** **69.18%**
**Maximum mark:** **85%**
**Minimum mark:** **55%**

Detailed comments on the paper are as follows:




## General Comments

When considering these comments, see also the Chair's narrative "B. NEW EXAMINING METHODS AND PROCEDURES".

As in previous years, the majority of the Part II theses were of a very high standard, and this was stressed by the External Examiners.

This year students were able to carry out their Part 2 projects in the normal way with little or no impact of Covid-19 on their ability to access laboratories or other resources. As such, students were not invited to submit a reflective account of the impact of Covid as they had been last year. It was noted however that due to a certain amount of backlog in research resulting from the pandemic, demand for shared resources was in some cases likely to be higher than usual. Students and supervisors were able to comment on these aspects in their project management forms and part A reports respectively.

# Examination Conventions 2021/22
# Materials Science - Final Honours School

## 1. INTRODUCTION

Examination conventions are the formal record of the specific assessment standards for the course or courses to which they apply. They set out how examined work will be marked and how the resulting marks will be used to arrive at a final result, a progression decision and/or classification of an award.

These conventions apply to the Final Honours School in Materials Science for the academic year 2021-22. The Department of Materials' Academic Committee (DMAC) is responsible for approving the Conventions and considers these annually, in consultation with the examiners. 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. Normally the relevant Regulations and MS FHS Handbook are the editions published in the year in which the candidate embarked on the FHS programme. The Examination Regulations may be found at: https://examregs.admin.ox.ac.uk/.

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.

The examiners are nominated by the Nominating Committee[1] of the Department and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. Formally, examiners act on behalf of the University and in this role are independent of the Department, the colleges and of those who teach the MS M.Eng. programme. However, for written papers on Materials Science in Part I examiners are expected to consult with course lecturers in the process of setting questions.

## 2. RUBRICS AND STRUCTURE FOR INDIVIDUAL PAPERS

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 suggested exemplar answer and marking schemes for every question set, including a clear allocation of marks for each part or sub-part of every question. These are annotated to indicate what is considered 'book-work', what is considered to be 'new material' requiring candidates to extend ideas from what has been covered explicitly in the course, and what is considered to be somewhere in between. This enables the examiners to identify how much of the question is accessible to less strong candidates and the extent to which the question has the potential to differentiate among the very best candidates. The marking scheme for each question aims to ensure that weaker candidates can gain marks by answering some parts of the question, and stronger candidates can show the depth of their understanding in answering other parts. The wording and content of all examination questions set, and the suggested exemplar answer and marking schemes, are scrutinised by all examiners, including the external examiners. The marking schemes are approved by the examining board alongside the papers.

Examiners check that questions are of a consistent difficulty within each paper and between papers.

Examiners proofread the final 'camera-ready' pdf version of each examination paper. Great care is taken to minimise the occurrence of errors or ambiguities. Despite this care, on occasion an error does remain in a paper presented to candidates: if a candidate thinks there is an error or mistake in the paper, then they must state what they believe the error to be and if necessary, state their understanding of the question.

All General Papers comprise eight questions from which candidates attempt five. Each question is worth 20 marks. The maximum number of marks available on each general paper is 100.

[1] for the 2021-22 examinations the Nominating Committee comprised Prof Assender, Prof Marrow & Dr Taylor.

Materials Option papers comprise one section for each twelve-hour Options lecture course, each section containing two questions worth 25 marks: 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 maximum 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.

The only types of calculators that may be used in examinations are from the following series:

CASIO fx-83
CASIO fx-85
SHARP EL-531

Candidates are required to clear any user-entered data or programmes from memories immediately before the exam begins. The invigilators may inspect any calculator during the course of an exam.

## 3. MARKING CONVENTIONS

### *3.1 University scale for standardised expression of agreed final marks*

Agreed final marks for individual papers will be expressed using the following scale: 0-100.

### *3.2 Qualitative criteria for different types of assessment*

Qualitative descriptors, based on those used across the Mathematical, Physical and Life Sciences Division, are detailed below:

| | |
|---|---|
| 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. The higher the mark in this band the greater will be the extent to which these criteria will be fulfilled; for marks in the 90-100 range there will be no more than a very small fraction, circa 5-10%, of the piece of work being examined that does not fully meet all of the criteria that are applicable to the type of work under consideration. The ‘piece of work’ might be, for example, an individual practical report, a question on a written paper, or a whole written paper. |
| 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. |
| 50-59 | The candidate shows basic problem-solving skills and adequate knowledge of most of the material. |
| 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. |
| 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. |
| 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. |

### *3.3 Verification and reconciliation of marks*

**Part I Written Papers**

During the marking process the scripts of all written papers remain anonymous to the markers. The markers are guided by the suggested exemplar answer and marking schemes.

All scripts are double marked, blind, by the setter and the checker each awarding an integer mark for each question. After individual marking the two examiners meet to agree marks question by question.

If the differences in marks are small (~10% of the maximum 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 Chair, 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.

In the event that a possible error in the paper has been identified, the examiners will consider the validity of the error and assess the impact of the error on candidates' choice of questions and on the answers written by those who attempted a question that contained an error, and will take this impact into account when marking the paper and prior to agreeing a final mark for all candidates.

The external examiners provide an independent check on the whole process of setting and marking.

**Part I Coursework**

In some of the descriptions of marking for individual elements of *coursework* 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.

(1) *Second Year Practicals*

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

(2) *Industrial Visits and Talks*

Reports on Industrial Visits and Industrial Talks are assessed by the Industrial Visits Academic Organiser on a satisfactory / non-satisfactory basis, and in total are allocated a maximum of 10 marks. Guidance on the requirements for the reports is provided at the annual 'Introduction to Industrial Visits' talk. Formative feedback is provided on the first of the Industrial Visit reports.

(3) *Entrepreneurship*

The business plan for the Entrepreneurship module is double marked, blind, by two assessors appointed by the Faculty of Materials. The written business plan is allocated a maximum of 20 marks. Guidance on the requirements for the written business plan and an outline marking scheme are published in the FHS Course Handbook. Further guidance is provided throughout the course, the slides from which are published on Canvas.

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.

(4) *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 a maximum of 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. Guidance on the requirements for the report and an outline marking scheme are provided in the 'Team Design Projects Briefing Note' published on Canvas.

(5) *Introduction to Modelling in Materials*

The reports for this module are double marked, blind, by the module assessors. Normally, at least one of the two assessors for each report will be a module organiser. The assessors then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each report.

The lead organiser for the Introduction to Modelling in Materials Module submits to the Assessors and Examiners of the module a short report which provides (i) a summary of the availability of the software & hardware required for each mini-project and (ii) any other pertinent information. The reports for the Introduction to Modelling in Materials module are allocated a maximum of 30 marks (each of two reports allocated a maximum of 15 marks). Guidance on the requirements for the reports and an outline marking scheme are published on Canvas.

(6) *Advanced Characterisation of Materials and Atomistic 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 organiser. The assessors then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each report. One of the Examiners oversees this process, sampling reports to ensure consistency between the different pairs of assessors and the two modules. The lead organiser 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 and/or data during the two-week module and (ii) any other pertinent information. An analogous report is provided by the lead organiser for the Atomistic Modelling Module in respect of the software & hardware required for the project. The report for the Characterisation Module is allocated a maximum of 30 marks and the report for the Atomistic Modelling Module is also allocated a maximum of 30 marks. For each module, guidance on the requirements for the reports and an outline marking scheme are published on Canvas.

**Part II Coursework**

The Part II project is assessed by means of a thesis which is submitted online to the Examiners, who will also take into account a written report from the candidate’s supervisor. The marking criteria are published in the Part II Course Handbook.

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.

The project is allocated a maximum of 400 marks, which is one third of the maximum available marks for Parts I and II combined. Two Part II examiners read the thesis (including the final chapter with the reflective accounts of project management, health, safety & risk assessment processes, and ethical and sustainability considerations), 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 seen 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. Any examiners who have supervised the candidate’s Part II project or are their college tutor will not be present at the viva or the subsequent discussion. Normally four individuals will have specified examining roles: Two examiners, or one examiner and an assessor, who have read the thesis entirely; the external examiner to whom the thesis was assigned; and an examiner acting as the session Chair who will complete any necessary documentation for that viva. Other examiners beyond these four individuals will be present to the extent possible given the existence of parallel sessions. A discussion involving all examiners present is held after the viva, during which 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 comments and provisional marks of the original markers, (ii) the candidate’s understanding of their work as demonstrated during the viva and (iii) the opinion of the external examiner who has seen the thesis.

If the two provisional marks allocated in advance of the viva differ significantly (that is, normally by more than 10% of the maximum available for a Part II 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.

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

## *3.4 Scaling*

**Part I Written Papers**

As the total number of candidates 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.

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 (a) 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.

**Part I Coursework**

Adjustment to marks, known as scaling, normally is not necessary for coursework.

The Practical Courses Organiser reviews the marks for the practicals before they are considered by the examiners, drawing to their attention (i) any anomalously low or high average marks for particular practicals and (ii) any factors that impacted on the practical course, such as breakdown of a critical piece of equipment. The examiners review the practical marks.

**Part II Coursework**

Adjustment to marks, known as scaling, normally is not necessary for the Part II theses.

## *3.5 Short-weight convention and departure from rubric*

***Part I Written Papers***

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 this information is not provided then the examiners will mark the questions in numerical order by question number. If the candidate lists more than the prescribed number of questions then questions will be marked in the order listed until the prescribed number has been reached. 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 above will be awarded and (iii) the mark for the paper will still be calculated out of 100. In addition, for the Materials Options Papers, as per the rubric, the examiners will mark questions from only three sections.

Should a candidate attempt questions from more than three sections the examiners will mark those questions from the first three sections in the order listed by the candidate on the covering page. If this information is not provided then the examiners will mark the sections in alphabetical order by section delineator (section A, section B, etc.).

**Part I Coursework**

It is a requirement for candidates to submit an element of coursework for each of the following: Practical Classes; Industrial Visits and Talks; Entrepreneurship Coursework (or substitution); Team Design Project; Introduction to Modelling in Materials, Advanced Characterisation of Materials or Atomistic Modelling. For the Practical Classes and Industrial Visits & Talks, the element of coursework comprises a set of reports: reports submitted on four Industrial Visits and two Industrial Talks and reports submitted on ten Practical Classes as specified in the Course Handbook. In these cases, a candidate must submit a report for each visit and talk/practical in order to satisfy the examiners. Failure to complete satisfactorily one or more elements of Materials Coursework normally will constitute failure of Part I of the Second Public Examination. Further details about this are provided in the Course Handbook.

### *3.6 Late- or non-submission of elements of coursework*

***Including action to be taken if submission has been or will be affected by illness or other urgent cause, and circumstances in which academic penalties may be applied.***

The Examination Regulations prescribe specific dates and times for submission of the required elements of coursework to the Examiners (1. One piece of Entrepreneurship Coursework; 2. A set of reports of practical work as specified in the Course Handbook (normally each individual report within the set has been marked already as the laboratory course progresses - penalties for late submission of an individual practical report are prescribed in the Course Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions.); 3. A Team Design Project Report and associated oral presentation; 4. A set of reports on Industrial Visits and Talks as specified in the course handbook; 5. A report on the work carried out in the Introduction to Modelling in Materials module; 6. A report on the work carried out in either the Characterisation of Materials module or the Atomistic Modelling module; and 7. A Part II Thesis). Rules governing late submission of these seven elements of coursework and any consequent penalties are set out in the 'Late submission and non-submission of a thesis or other written exercise' clause of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations (Part 14, 'Late Submission, Non-submission, Non-appearance and Withdrawal from Examinations' in the 2021/22 Regulations). A candidate who fails to submit an element of coursework by a prescribed date and time will be notified of this by means of an email sent on behalf of the Chair of Examiners.

Under the provisions permitted by the regulation, late submission of an element of coursework, as defined above, for Materials Science examinations will normally result in one of the following:

(a) Under paras 14.4 to 14.8. In a case where illness or other urgent cause has prevented or will prevent a candidate from submitting an element of coursework at the prescribed date, time and place the candidate may, **through their college**, request the Proctors to accept an application to this effect. In such circumstances the candidate is **strongly** advised to (i) carefully read paras 14.4 to 14.8 of the aforesaid Part 14, where the mandatory contents of such an application to the Proctors are outlined and the several possible actions open to the Proctors are set out, and (ii) both seek the guidance of their college Senior Tutor and inform at least one of their college Materials Tutorial Fellows. Some, but not all, of the actions open to the Proctors may result in the work being assessed as though it had been submitted on time (and hence with no late submission penalty applied).

(b) Under para 14.9. In the case of submission on or after the prescribed date for the submission and within 14 calendar days of notification of non-submission and without prior permission from the Proctors: subject to leave from the Proctors to impose an academic penalty, 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 the circumstances as advised by the Proctors. The reduction may not take the mark below 40%.

(c) Under Para 14.4(4). In the case of failure to submit within 14 calendar days of the notification of non-submission and without prior permission from the Proctors: a mark of zero shall be recorded for the element of coursework and normally the candidate will have failed Part I or II as appropriate of the Examination as a whole.

If a candidate is unable to submit by the required date and time for any reason other than for acute illness their college may make an application to the Proctors for permission for late submission. An extended deadline may be approved, or late submission excused where there are grounds of 'illness or other urgent cause'. Applications may be made in advance of a deadline, or up to 14 days from when the candidate is notified that they have not submitted. In all cases, the applications will be considered on the basis of the evidence provided to support the additional time sought.

It should be noted that the maximum extension that the examiners can accommodate for a Part II thesis to be examined in the 2021/22 session is 14 days. Any extension awarded for longer shall mean the assessment will normally be considered by the scheduled examination board in the next academic year.

Elements of coursework comprising more than one individual piece of assessed coursework

Penalties for late submission of individual practical reports are set out in the 2020/21 MS FHS Handbook and are **separate** to the provisions described above.

The consequences of failure to submit individual practical reports or failure to submit/deliver other individual pieces of assessed coursework that contribute to one of the *elements* of coursework scheduled in the Special Regulations for the Honour School of Materials Science are set out in the MS FHS Handbook (sections 7 and 10.7 of the 2020/21 version) and are **separate** to the provisions described above. In short normally this will be deemed to be a failure to complete satisfactorily the relevant element of Materials Coursework and will therefore constitute failure of Part I of the Second Public Examination.

Where an individual practical report or other individual piece of assessed coursework that contributes to one of the *elements* of coursework scheduled in the Special Regulations for the Honour School of Materials Science is not submitted or is proffered so late that it would be impractical to accept it for assessment the Proctors may, exceptionally, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chair of the Examiners, permit the candidate to remain in the examination. In this case *for the individual piece of coursework in question* (i) the Examiners will award a mark of zero and (ii) dispensation will be granted from the Regulation that requires submission/delivery of every individual piece of assessed coursework if the candidate is not to fail the examination as a whole.

### *3.7 Penalties for over-length work and departure from approved titles or subject-matter*

For elements of coursework with a defined word limit: if a candidate exceeds this word limit without permission normally the examiners will apply a penalty of 10% of the maximum mark available for the piece of work. [It is only possible to apply for permission to exceed a word limit if the Examination Regulations for the specific element of coursework concerned state explicitly that such an application is permitted, excepting that the Proctors may, exceptionally, under their general authority grant such permission.]

### *3.8 Penalties for poor academic practice*

Substantial guidance is available to candidates on what constitutes plagiarism and how to avoid committing plagiarism (see Appendix B of the 20/21 FHS Course Handbook and https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1 )

If plagiarism is suspected, the evidence will be considered by the Chair of the Examiners (or a deputy). He or she will make one of three decisions (https://academic.admin.ox.ac.uk/examiners):

(d) No evidence, or insufficient evidence, of plagiarism – no case to answer.

(e) Evidence suggestive of more than a limited amount of low-level plagiarism – referred to the Proctors for investigation and possible disciplinary action.

(f) Evidence proving beyond reasonable doubt that a limited amount of low-level plagiarism has taken place – in this case the Board of Examiners will consider the case and if they endorse the Chair's judgement that a limited amount of low-level plagiarism has taken place will select one of two actions:

(iii) Impose a penalty of 10% of the maximum mark available for the piece of work in question and a warning letter to be issued to the candidate explaining the offence and that the present incident will be taken into account should there be a further incidence of plagiarism. For a student who remains on course in addition there will be a requirement to demonstrate to their college Materials Tutorial Fellow that in the period between the present offence and the next submission of work for summative assessment they have followed to completion the University's on-line course on plagiarism (https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1 ).

(iv) No penalty, but a warning letter to be issued to the candidate explaining the offence, indicating that on this occasion it has been treated as a formative learning experience, and that the present incident will be taken into account should there be a further incidence of plagiarism. For a student who remains on course in addition there will be a requirement to demonstrate to their college Materials Tutorial Fellow that in the period between the present offence and the next submission of work for summative assessment they have followed to completion the University's on-line course on plagiarism (https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1 ).

### *3.9 Penalties for non-attendance*

Unless the Proctors have accepted a submission requesting absence from an examination, as detailed in Section 14 of the Regulations, failure to attend a written examination in Part I or the *viva voce* examination in Part II will result in the failure of the whole Part.

## 4. PROGRESSION RULES AND CLASSIFICATION CONVENTIONS

### *4.1 Qualitative descriptors of classes (FHS)*

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 II(i) 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 II(ii) 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 reaching their decisions the examiners are not permitted to refer to a candidate's outcome in, or profile across the assessments in, the First Public Examination ('Prelims').

In borderline cases the examiners use their discretion and consider the quality of the work the candidate has presented for examination over the whole profile of FHS assessments; thus for Part I outcomes the Part I assessments, and for overall degree outcomes the assessments for both Parts I and II. The external examiners often play a key role in such cases.

### *4.2 Classification rules (FHS)*

**Part I:**

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. The examiners do not divide the categories further but tutors and students may infer how well they have done from their marks.

*Unclassified Honours* –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 and normally obtained a minimum mark of 50% averaged over all elements of assessment for the Part I Examination.

Candidates adjudged worthy of honours and obtaining a minimum mark of 50% averaged over all elements of assessment for the Part I Examination 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.

Candidates adjudged worthy of honours who do not obtain a minimum mark of 50% averaged over all elements of assessment for the Part I Examination 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 or may retake Part I the following year (subject to college approval).

*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 be waived only in exceptional circumstances, with permission from the Education Committee.

### *4.3 Progression rules*

The attention of candidates for Part I of the Examination is drawn to key phrases in clauses 8 and 11 of Section A and clause 3 under Part I of Section B of the Special Regulations for the Honour School of Materials Science:

> Section A. 8. No candidate for the degree of Master of Engineering in Materials Science may present him or herself for examination in Part II unless he or she has (a) been adjudged worthy of Honours by the Examiners in Part I and (b) normally obtained a minimum mark of 50% averaged over all elements of assessment for the Part I Examination.
>
> Section A. 11. To achieve Honours at Part I normally a candidate must fulfil all of the requirements under (a), (b) & (c) of this clause. (a) Obtain a minimum mark of 40% averaged over all elements of assessment for the Part I Examination, (b) obtain a minimum mark of 40% in each of at least four of the six written papers sat in Trinity Term of the year of Part I of the Second Public Examination, and (c) satisfy the coursework requirements set out in Section B, Part I [of the Regulations].
>
> Section B. Part I. 3. In the assessment of the Materials coursework, the Examiners shall take into consideration the requirement for a candidate to complete satisfactorily the coursework to a level prescribed from time to time by the Faculty of Materials and published in the Course Handbook. Normally, failure to complete satisfactorily all six elements of Materials Coursework will constitute failure of Part I of the Second Public Examination.

### *4.4 Use of vivas*

*There are no vivas in the Part I examination.*

*In Part II,* a *viva voce* examination is held for all candidates.

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.

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.

## 5. RESITS

In the event that a candidate obtains a mark of less than 50% averaged over all elements of assessment of Part I, or if a candidate fails to satisfy the examiners, a resit is permitted. Such a candidate may re-enter for the whole of the Part I examination on one occasion only, normally in the examining session in Trinity Term 2023, following the examiners' original decision. The examination will cover the same material as the original examination and will follow the same rubric. If such a candidate is adjudged worthy of honours and achieves a mark of 50% or more averaged over all elements of assessment in Part I, the candidate may progress to Part II but will carry forward only a capped mark of 50% for Part I.

Part II may be entered on one occasion only.

## 6. MITIGATING CIRCUMSTANCES NOTICES TO EXAMINERS (MCE)

[For **late- or non-submission** of elements of coursework, including cases due to illness or other urgent cause, see section 3.6 of the present Conventions.]

A candidate's final outcome will first be considered using the classification rules/final outcome rules as described above in section 4. Cohort-wide adjustments will then be considered, e.g. any scaling. The exam board will then consider any further information they have on individual circumstances.

There are two applicable sections of the University's *Examination Regulations*.

• **Part 13 Mitigating Circumstances: Notices to Examiners** relates to unforeseen circumstances which may have an impact on a candidate's performance.
• **Part 12 Candidates with Special Examination Needs** relates to students with some form of disability.

Whether under Part 12 or Part 13, a mitigating circumstances notice to examiners should be submitted by the candidate through student self-service/eVision, or by the college on behalf of the candidate as soon as circumstances come to light. Candidates with alternative arrangements under Part 12 will not be considered under this mitigating circumstances process if they do not submit a separate mitigating circumstances notice.

Where a candidate or candidates have made a submission, under Part 12 or Part 13, that unforeseen circumstances may have had an impact on their performance in an examination, a subset of the internal examiners will meet to discuss the individual applications and band the seriousness of each application on a scale of 1-3 with 1 indicating minor impact, 2 indicating moderate impact, and 3 indicating very serious impact.

For Part I, normally, this MCE meeting will take place before Part A of the meeting of the internal examiners at which the examination results are reviewed. When reaching these Part I decisions on MCE impact level, a subset of internal examiners will take into consideration, on the basis of the information received, the severity and relevance of the circumstances, and the strength of the evidence provided in support. This subset of examiners will also note whether all or a subset of written papers and/or elements of coursework were affected, being aware that it is possible for circumstances to have different levels of impact on different written papers and elements of coursework. The banding information is used at Part B of the meeting of the Part I internal examiners at which the examination results are reviewed: in Part B a candidate's results are discussed in the light of the impact of each MCE and recommendations to the Finals Board formulated regarding any action(s) to be taken in respect of each MCE.

For Part II, a subset of internal examiners will meet to band the seriousness of each notice in advance of the Part II vivas and prior to sight of any preliminary marks awarded by the internal examiners. When reaching these decisions on MCE impact level, the subset of examiners will take into consideration, on the basis of the information received, the severity and relevance of the circumstances, and the strength of the evidence. The banding information will be used at Part B of the meeting of Part II internal examiners, which is held after the vivas, at which the marks agreed following the discussion after the viva are reviewed and recommendations to the Finals Board formulated regarding any action(s) to be taken in respect of each MCE.

Further information on the procedure is provided in the *Examination and Assessment Framework, Annex E* and information for students is provided at https://www.ox.ac.uk/students/academic/exams/problems-completing-your-assessment. It is very important that a candidate's MCE submission is adequately evidenced and, where appropriate, verified by their college; the University forbids the Board of Examiners from seeking any additional information or evidence.

Candidates who have indicated they wish to be considered for DDH/DDM[2] will first be considered for a classified degree, taking into account any individual MCE. If that is not possible and they meet the DDH/DDM eligibility criteria, they will be awarded DDH/DDM.

## 7. DETAILS OF EXAMINERS AND RULES ON COMMUNICATING WITH EXAMINERS

The Materials Science Examiners in Trinity 2022 are: Prof. Simon Benjamin, Prof. Sergio Lozano-Perez, Prof. James Marrow, Prof. Pete Nellist, Prof. Keyna O'Reilly, and Prof. Jason Smith (Chair). The external examiners are Prof. Geraint Williams, Swansea University, and Prof. Peter Haynes, Imperial College, London.

[2] DDH/DDM – Declared to have Deserved Honours / Declared to have Deserved Masters

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 candidate's college, who will, if the matter is deemed of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Examiners.

Candidates should not under any circumstances seek to make contact with individual internal or external examiners.

## ANNEX

**Summary of maximum marks available to be awarded for different components of the MS Final Examination in 2022 (For Part I and Part II students who embarked on the FHS respectively in 2020/21 and 2019/20)**

| | 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 | 60 |
| | Industrial Visits and Talks | 10 |
| | Entrepreneurship coursework | 20 |
| | Team Design Project | 50 |
| | Introduction to Modelling in Materials | 30 |
| | Characterisation or Atomistic Modelling module | 30 |
| *Part I Total* | | *800* |
| **Part II** | Thesis | 400 |
| *Overall Total* | | *1200* |

## 8. APPENDIX – B.A. IN MATERIALS SCIENCE (EXIT AWARD ONLY)

In their 3rd year, a candidate may opt to transfer out of the M.Eng. programme and seek to exit with a classified B.A. award, via one of the following routes:

- Route 1 – Transfer to the B.A. at the start of the 3rd year
- Route 2 – Transfer to the B.A. at the end of the 3rd year

### Route 1

Such a candidate will have studied a reduced subset of Options courses and undertaken an additional element of coursework, comprising a literature-based research module. In this case, the candidate will sit the same Option papers as all other Part I candidates but for each paper will answer only two questions in a reduced timeframe of 1.5 hours. The maximum number of marks available on each option paper is 50, and questions carry equal marks. The literature-based research module will be assessed by means of an extended essay of up to 4,000 words which is submitted to the examiners, who will also take into account a written report from the candidate's academic advisor for this research module. The essay is double marked, blind, by two examiners and allocated a maximum of 50 marks.

### Route 2

Such a candidate will have completed the same elements of assessment as for Part I of the M.Eng. and in addition will be required to undertake a literature-based research module during the Long Vacation following the written papers. Consideration of all the results will be made by the examiners in the Trinity term of the year following the written papers. The literature-based research module will be assessed by means of an extended essay of up to 4,000 words which is submitted to the examiners, who will also take into account a written report from the candidate's academic advisor for this research module. The essay is double marked, blind, by two examiners and allocated a maximum of 50 marks.

The examiners will apply to the extended essay the conventions detailed above in relation to:

- *Short-weight and departure from rubric*
- *Late or non-submission*
- *Over-length work and departure from approved titles or subject-matter*

The examiners will apply the conventions that relate to the M.Eng. as detailed above to all other elements of assessment for the B.A.

The qualitative descriptors of classes given in Section 4.1 also apply to the B.A.

Once marking is completed an overall percentage mark is computed for each candidate and classification then takes place. Subject to being adjudged worthy of honours, classification is based solely on the overall percentage mark; the candidate's profile of marks from each element of assessment is taken into account only in borderline cases.

*Classified Honours* – To be adjudged worthy of Honours normally a candidate must obtain a minimum mark of 40% averaged over all elements of assessment, obtain a minimum mark of 40% in each of at least four of the six written papers, and satisfy the coursework requirements.

*Pass* – The examiners consider that the candidate's overall performance has reached an adequate standard but is not worthy of Honours. The candidate is listed as a Pass on the class list and is awarded a B.A. (without honours).

*Fail* – The examiners consider that the candidate's overall performance is not worthy of a B.A.

In the event that a candidate obtains a mark of less than 40% averaged over all elements of assessment, or if a candidate fails to satisfy the examiners, a **resit** is permitted. Such a candidate may re-enter for the whole of the examination on one occasion only, normally in the year following the examiners' original decision. The examination will cover the same material as the original examination and will follow the same rubric. If such a candidate is adjudged worthy of honours, as defined under 'Classified Honours' above, the examiners may award a 3rd class Honours classification. The Examiners shall be entitled to award a Pass to a candidate who has reached a standard considered adequate but who has not been adjudged worthy of Honours on the occasion of this resit.

## ANNEX

**Summary of maximum marks available to be awarded for different components of the MS Final Examination in the B.A. (Hons) exit award in 2022**

Route 1

| | Component | Mark |
|---|---|---|
| **Part I** | General Paper 1 | 100 |
| | General Paper 2 | 100 |
| | General Paper 3 | 100 |
| | General Paper 4 | 100 |
| | Materials Options Paper 1 | 50 |
| | Materials Options Paper 2 | 50 |
| | Practicals | 60 |
| | Industrial Visits and Talks | 10 |
| | Entrepreneurship coursework | 20 |
| | Team Design Project | 50 |
| | Introduction to Modelling in Materials | 30 |
| | Characterisation or Atomistic Modelling module | 30 |
| | Literature-based research module | 50 |
| **Overall Total** | | **750** |

Route 2

| | 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 | 60 |
| | Industrial Visits and Talks | 20 |
| | Entrepreneurship coursework | 20 |
| | Team Design Project | 50 |
| | Introduction to Modelling in Materials | 30 |
| | Characterisation or Atomistic Modelling module | 30 |
| | Literature-based research module | 50 |
| **Overall Total** | | **850** |

## 8. APPENDIX – B.A. IN MATERIALS SCIENCE (EXIT AWARD ONLY)

In their 3rd year, a candidate may opt to transfer out of the M.Eng. programme and seek to exit with a classified B.A. award, via one of the following routes:

- Route 1 – Transfer to the B.A. at the start of the 3rd year
- Route 2 – Transfer to the B.A. at the end of the 3rd year

**Route 1**

Such a candidate will have studied a reduced subset of Options courses and undertaken an additional element of coursework, comprising a literature-based research module. In this case, the candidate will sit the same Option papers as all other Part I candidates but for each paper will answer only two questions in a reduced timeframe of 1.5 hours. The maximum number of marks available on each option paper is 50, and questions carry equal marks. The literature-based research module will be assessed by means of an extended essay of up to 4,000 words which is submitted to the examiners, who will also take into account a written report from the candidate's academic advisor for this research module. The essay is double marked, blind, by two examiners and allocated a maximum of 50 marks.

**Route 2**

Such a candidate will have completed the same elements of assessment as for Part I of the M.Eng. and in addition will be required to undertake a literature-based research module during the Long Vacation following the written papers. Consideration of all the results will be made by the examiners in the Trinity term of the year following the written papers. The literature-based research module will be assessed by means of an extended essay of up to 4,000 words which is submitted to the examiners, who will also take into account a written report from the candidate's academic advisor for this research module. The essay is double marked, blind, by two examiners and allocated a maximum of 50 marks.

The examiners will apply to the extended essay the conventions detailed above in relation to:

- *Short-weight and departure from rubric*
- *Late or non-submission*
- *Over-length work and departure from approved titles or subject-matter*

The examiners will apply the conventions that relate to the M.Eng. as detailed above to all other elements of assessment for the B.A.

The qualitative descriptors of classes given in Section 4.1 also apply to the B.A.

Once marking is completed an overall percentage mark is computed for each candidate and classification then takes place. Subject to being adjudged worthy of honours, classification is based solely on the overall percentage mark; the candidate's profile of marks from each element of assessment is taken into account only in borderline cases.

*Classified Honours* – To be adjudged worthy of Honours normally a candidate must obtain a minimum mark of 40% averaged over all elements of assessment, obtain a minimum mark of 40% in each of at least four of the six written papers, and satisfy the coursework requirements.

*Pass* – The examiners consider that the candidate's overall performance has reached an adequate standard but is not worthy of Honours. The candidate is listed as a Pass on the class list and is awarded a B.A. (without honours).

*Fail* – The examiners consider that the candidate's overall performance is not worthy of a B.A.

In the event that a candidate obtains a mark of less than 40% averaged over all elements of assessment, or if a candidate fails to satisfy the examiners, a **resit** is permitted. Such a candidate may re-enter for the whole of the examination on one occasion only, normally in the year following the examiners' original decision. The examination will cover the same material as the original examination and will follow the same rubric. If such a candidate is adjudged worthy of honours, as defined under 'Classified Honours' above, the examiners may award a 3rd class Honours classification. The Examiners shall be entitled to award a Pass to a candidate who has reached a standard considered adequate but who has not been adjudged worthy of Honours on the occasion of this resit.

## ANNEX

**Summary of maximum marks available to be awarded for different components of the MS Final Examination in the B.A. (Hons) exit award in 2021**

Route 1

| | Component | Mark |
|---|---|---|
| **Part I** | General Paper 1 | 100 |
| | General Paper 2 | 100 |
| | General Paper 3 | 100 |
| | General Paper 4 | 100 |
| | Materials Options Paper 1 | 50 |
| | Materials Options Paper 2 | 50 |
| | Practicals | 60 |
| | Industrial visits | 20 |
| | Engineering and Society coursework | 20 |
| | Team Design Project | 50 |
| | Introduction to Modelling in Materials | 25 |
| | Characterisation or Atomistic Modelling module | 25 |
| | Literature-based research module | 50 |
| **Overall Total** | | **750** |

Route 2

| | 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 | 60 |
| | Industrial visits | 20 |
| | Engineering and Society coursework | 20 |
| | Team Design Project | 50 |
| | Introduction to Modelling in Materials | 25 |
| | Characterisation or Atomistic Modelling module | 25 |
| | Literature-based research module | 50 |
| **Overall Total** | | **850** |

# Reports from the External Examiners for Materials

| | |
|---|---|
| **External examiner name:** | Peter Haynes |
| **External examiner home institution:** | Imperial College London |
| **Course(s) examined:** | Materials Science, Part I and Part II |
| **Level:** (please *delete as appropriate*) | Undergraduate ~~Postgraduate~~ |

***Please complete both Parts A and B.***

| **Part A** | | | | |
|---|---|---|---|---|
| | *Please (✓) as applicable** | **Yes** | **No** | **N/A / Other** |
| A1. | Are the academic standards and the achievements of students comparable with those in other UK higher education institutions of which you have experience? *[Please refer to paragraph 6 of the Guidelines for External Examiner Reports].* | ✓ | | |
| A2. | Do the threshold standards for the programme appropriately reflect the frameworks for higher education qualifications and any applicable subject benchmark statement? *[Please refer to paragraph 7 of the Guidelines for External Examiner Reports].* | ✓ | | |
| A3. | Does the assessment process measure student achievement rigorously and fairly against the intended outcomes of the programme(s)? | ✓ | | |
| A4. | Is the assessment process conducted in line with the University's policies and regulations? | ✓ | | |
| A5. | Did you receive sufficient information and evidence in a timely manner to be able to carry out the role of External Examiner effectively? | ✓ | | |
| A6. | Did you receive a written response to your previous report? | ✓ | | |
| A7. | Are you satisfied that comments in your previous report have been properly considered, and where applicable, acted upon? | ✓ | | |

**** If you answer "No" to any question, you should provide further comments when you complete Part B.***

**Part B**

In your responses to these questions, please could you include comments on the effectiveness of any changes made to the course or processes in response to the COVID-19 pandemic where appropriate.

**B1. Academic standards**

a. *How do academic standards achieved by the students compare with those achieved by students at other higher education institutions of which you have experience?*

The Department is maintaining academic standards: the slight upward trend in outcomes over time is consistent with improvements to the delivery of the course and greater student engagement (due to tuition fees) driving higher attainment. Student achievements compare well against students within the same classifications at my own institution, and I believe that slightly fewer First class degrees were awarded this year than in 2021.

b. *Please comment on student performance and achievement across the relevant programmes or parts of programmes and with reference to academic standards and student performance of other higher education institutions of which you have experience (those examining in joint schools are particularly asked to comment on their subject in relation to the whole award).*

It was a pleasure to participate in the Part II research project vivas in person this year. Students were not always sure of how to deliver their opening statement and the Department might wish to give some guidance on this the week before (or remind students of where this is to be found). Overall, my sense this year was that the introductions of the dissertations did not convey the same level of appreciation of the wider context of their projects as before the pandemic, but as I commented last year this could be accounted for by the lack of opportunities for interactions during the pandemic. However, the dissertations were better presented than last year, although as ever a few had left it too late. Students did not seem to have achieved as much in the lab as in the past, but this would also be accounted for by the need to prioritise access to facilities by DPhil students delayed by the pandemic. It was noticeable that many more projects involved a computational element and the wide range of skills demonstrated is impressive. As was the case before the pandemic, the best projects had generated publishable results.

Although the raw Part I examination marks were lower than in recent years, in light of the pandemic student performance was still impressive and their achievements compare favourably with those at my own institution.

**B2. Rigour and conduct of the assessment process**

*Please comment on the rigour and conduct of the assessment process, including whether it ensures equity of treatment for students, and whether it has been conducted fairly and within the University's regulations and guidance.*

This year's Part I papers had been prepared to a very high standard indeed and contained very few errors. I received a very detailed response to my suggestions and comments.

I was also impressed with the approach taken to adjusting the examination paper marks, by reviewing scripts to compare them with the qualitative criteria in the Examination Conventions. This gave me a high degree of confidence in the robustness and fairness of the procedure.

**B3. Issues**

*Are there any issues which you feel should be brought to the attention of supervising committees in the faculty/department, division or wider University?*

I am concerned by a perceived disconnect between the handling of requests for extensions and mitigating circumstances. My understanding is that Proctors handle extension requests and do not inform the Department of the reasoning behind their decision. However, the Examiners then handle mitigating circumstances requests and there is no communication between the two. It seems to me that there is a real risk here that students can 'double dip' and potentially gain an advantage. Moreover, the Proctors cannot be aware of the impact of an extension on workloads: in my own institution we are very cautious about granting extensions, as this tends to generate clashes with other deadlines or to put pressure on the assessment process. I would recommend that these arrangements should be reviewed. It seems to me it would be better if the Department were to handle extension requests in the first instance with the right of appeal to the Proctors.

The Department had received a complaint from several students about the preparation and guidance they had received for in-person examinations. I was impressed by the approach taken to dealing with this: a careful investigation was undertaken by a senior academic with past experience of being an Examiner (although not appointed this year so independent). I agreed with the reasoning and conclusion of his report, which did not uphold the complaint.

**B4. Good practice and enhancement opportunities**

*Please comment/provide recommendations on any* ***good practice and innovation relating to learning, teaching and assessment****, and any* ***opportunities to enhance the quality of the learning opportunities*** *provided to students that should be noted and disseminated more widely as appropriate.*

Double-blind marking of examination papers has advantages and may be considered to be the gold standard, but as I have noted before, I am not convinced that the benefits justify the cost. This year I reviewed some scripts and there were systematic differences between examiners that were then averaged. For example, some examiners are reluctant to award zero marks for an answer that is lengthy but has no merit according to the marks scheme. This difference can lead to an increase of 1 mark out of 20 for every question in a paper, or 5% in the total. Moreover, the 'check' marking that is more commonly carried out in most institutions has an advantage that the second marker gains a better overview of the overall pattern of marks, and whether the first marker's approach has changed over time. I understand that the Department will be asking lecturers to act as one of the markers for the General Papers next year. I support this move, along with the decision to analyse this year's data to see what the impact of only having one marker would have been. A minor point is that I am not sure that the total for each question should be rounded up until the two initial marks have been reconciled.

During the Part I Board there were some comments about the difference in averages between the characterisation and modelling coursework (students opt for one of these). I would caution against a direct comparison between these, but encourage the Department to review these in the context of the average marks on the General Papers for the students who chose each option.

**B5. Any other comments**

*Please provide any other comments you may have about any aspect of the examination process. Please also use this space to address any issues specifically required by any applicable professional body. If your term of office is now concluded, please provide an overview here.*

I have completed my four-year term as an external examiner this year and it has been a very positive experience throughout. The administrative support provided by the Department to the examination process has been consistently excellent and all of the Chairs of Examiners have been impressive in their commitment to a demanding and important task.

In my review of the examination papers this year I was struck that I have witnessed very little repetition of questions over the years. I find this extremely impressive and to the great credit of all those setting questions.

I mentioned two general and connected points for consideration in my final remarks to the Board. The first is that I believe it would be healthy to involve a wider range of academic staff in the examination process. The Department has already taken steps in this direction, by involving a panel of assessors in the marking of Part II dissertations, and will take further steps by involving lecturers in the marking of the General Papers next year. There is value in enabling lecturers to see evidence of student attainment first-hand and project supervisors to understand the expectations of the Examiners. I encourage the Department to consider further steps that it might take in this direction. Second, the workload for the Examiners is extremely high, and is growing with the size of the cohort. In my view it is already at the limit of what is acceptable. My own recommendation is that the first marking of examination papers should be carried out by lecturers and then reviewed and checked by the Examiners, but this should be considered only after the changes already proposed to the marking of the General Papers next year.

| | |
|---|---|
| **Signed:** | |
| **Date:** | 8 July 2022 |

| | |
|---|---|
| **External examiner name:** | Prof Geraint Williams |
| **External examiner home institution:** | Swansea University |
| **Course(s) examined:** | Materials Science Parts I and II |
| **Level:** (please *delete as appropriate*) | Undergraduate |

***Please complete both Parts A and B.***

| **Part A** | *Please (✓) as applicable** | **Yes** | **No** | **N/A / Other** |
|---|---|---|---|---|
| A1. | Are the academic standards and the achievements of students comparable with those in other UK higher education institutions of which you have experience? *[Please refer to paragraph 6 of the Guidelines for External Examiner Reports].* | ✓ | | |
| A2. | Do the threshold standards for the programme appropriately reflect the frameworks for higher education qualifications and any applicable subject benchmark statement? *[Please refer to paragraph 7 of the Guidelines for External Examiner Reports].* | ✓ | | |
| A3. | Does the assessment process measure student achievement rigorously and fairly against the intended outcomes of the programme(s)? | ✓ | | |
| A4. | Is the assessment process conducted in line with the University's policies and regulations? | ✓ | | |
| A5. | Did you receive sufficient information and evidence in a timely manner to be able to carry out the role of External Examiner effectively? | ✓ | | |
| A6. | Did you receive a written response to your previous report? | ✓ | | |
| A7. | Are you satisfied that comments in your previous report have been properly considered, and where applicable, acted upon? | ✓ | | |

**** If you answer "No" to any question, you should provide further comments when you complete Part B.***

**Part B**

In your responses to these questions, please could you include comments on the effectiveness of any changes made to the course or processes in response to the COVID-19 pandemic where appropriate.

**B1. Academic standards**

a. *How do academic standards achieved by the students compare with those achieved by students at other higher education institutions of which you have experience?*

**A return to in-person teaching in the 2021-22 academic session has not changed my overall impression of the standard of academic achievement by the part I and part II student cohort this year. As per my comments of last year, the standards compare extremely favourably with Materials Science degree schemes at other UK universities.**

b. *Please comment on student performance and achievement across the relevant programmes or parts of programmes and with reference to academic standards and student performance of other higher education institutions of which you have experience (those examining in joint schools are particularly asked to comment on their subject in relation to the whole award).*

**The in-person external examiner visit in late June this year afforded me a first opportunity since the start of my appointment to meet with a selection of part II candidates as part of the research project viva process. In the majority of the 20 vivas conducted over the course of my 4 day visit, the standard of student performance was excellent, with most students able to discuss their results confidently and offer plausible answers to questions posed by the three examiners. In general however I felt that the quantity of results in some of the dissertations I examined was perhaps slightly less than I would have anticipated for a 10 month research project. From perusing the project management forms appended to each thesis, a common theme seemed to be delays in training or difficulties in accessing relevant equipment. This is probably a consequence of heightened post-Covid demand for research instrumentation from a combination of returning post-doctoral, postgraduate and part II undergraduate cohorts making up for lost time. I anticipate that as the post-pandemic recovery gathers pace next year ,this situation will improve and that next year's part II cohort will be able to accrue more empirical data to include in their part II write-ups. Despite this, student achievements in the research project aspect of the MEng course are of high standard and again compare favourably with other institutions which provide Materials Science and Engineering schemes.**

**This year saw the welcome return of part I assessment to a familiar in-person, invigilated examination format after the open-book, online assignment system used during the height of the pandemic. As anticipated, the average marks for each of the 6 papers was generally lower this year than the previous two years, as a consequence of the closed-book format. Nevertheless, during my perusal of a selection of exam scripts some of the answers submitted by the top students were outstanding and in-line with the model answers. During the limited time available to scrutinise part I course material, including practical assignments, group projects and exam scripts, there seemed to be a clear correlation of the mark awarded with the standard of the submitted work. Despite the lower average marks this year, I still consider the level of performance of the students in part I exams to equal, if not exceed those on materials courses in other leading UK universities.**

**B2. Rigour and conduct of the assessment process**

*Please comment on the rigour and conduct of the assessment process, including whether it ensures equity of treatment for students, and whether it has been conducted fairly and within the University's regulations and guidance.*

**This year's return to in-person vivas as part of the assessment of the part II research projects, involving the participation of the external examiner in addition to two internal assessors/examiners provided me with a better indication of the rigour of the assessment process compared to last year's remote format. In last year's report I questioned why the viva did not comprise a short powerpoint presentation by the student about the highlights of their project. However, in the case of face-to-face vivas I could recognise that the procedure of giving the student a few minutes at the start of proceedings to give a succinct summary of their work without a visual aid was probably a more valuable assessment measure than a brief powerpoint talk. The vivas were conducted in a fair, open and friendly manner and the marking rubric and comments form used by the internal assessors allowed clear evaluation and justification of the apportioning of marks. The 15 min or so allotted between vivas was useful in allowing the external and examination board the opportunity to discuss individual opinions regarding the dissertations and the decide their respective lines of questioning.**

**With regard to the part I examination process, which this year reverted to traditional, invigilated in-person examinations, requiring to students to submit hand written answers to the six different papers, the assessment remains highly rigorous. As noted in my previous report, Oxford's approach in using two independent academic examiners and double blind marking of general papers is very time-consuming, as is the process of agreeing final marks for each question where there is a divergence in grading. The approach taken in the marking of the two options papers is perhaps a more conventional one, where the question setters mark their respective questions along with one of the examiners.**

**B3. Issues**

*Are there any issues which you feel should be brought to the attention of supervising committees in the faculty/department, division or wider University?*

**Again this year there seemed to be a considerable number of mitigating circumstances to consider within the external exam board meeting. Despite the large number, all were handled very efficiently and in line with university regulations.**

**During the course of the 3 days of part II vivas, the external examiners were also asked to comment on a complaint submitted to the Proctors by a group of five part I students regarding some of their written exams. The complaint centred on some advice given by a member of academic staff regarding the style of questioning which would be used in part I exams. A senior member of academic staff who was not a member of this year's examinations board was tasked with investigating the complaint and provided a detailed report which concluded that there was little merit in the complaint. I am confident that this complaint was dealt with in a rigorous and appropriate manner and happy to concur with the verdict that the complaint was without foundation.**

**It was also noted that marks for most of the Part 1 papers were generally lower than preceding years. As such the exam board introduced a scaling process to bring the average marks in line with previous years and historical trends. The exam board chairman explained the procedure and justification of the extent of scaling in detail, so I am confident that everything was carried out in a transparent nature and adherent to the university's exam conventions.**

**Although most of the internal assessors' marks for part II thesis submissions were generally in good agreement, there were again several instances where there was a large divergence (by 15-20 marks). Frequently, the discrepancies are seen in cases where the thesis is one of the first to be scrutinised by the assessor/examiner prior to having a better balanced view of the general standard of the cohort after reading through multiple dissertations. As such the opinion of the external examiner was sought in finding an acceptable compromise after the viva. I feel that maybe some guidance should be provided to the thesis examiners on "best-practice" in agreeing a final mark where the individual marks differ by such large margins. It was also noted that for part I paper marking, there were several cases in which the two examiner marks varied by a considerable margin of 5-6 marks for a 20 mark question. Although there is a mechanism in the examiner's comments forms to explain how a final mark was agreed, in many cases there no entry to justify the mark agreed between the two examiners.**

**B4. Good practice and enhancement opportunities**

*Please comment/provide recommendations on any* ***good practice and innovation relating to learning, teaching and assessment****, and any* ***opportunities to enhance the quality of the learning opportunities*** *provided to students that should be noted and disseminated more widely as appropriate.*

**The newly installed system of scanning the part I hand-written exam scripts and uploading electronic pdf version onto the examiners sharepoint site has been widely welcomed and has allowed the markers to complete their work more efficiently.**

**B5. Any other comments**

*Please provide any other comments you may have about any aspect of the examination process. Please also use this space to address any issues specifically required by any applicable professional body. If your term of office is now concluded, please provide an overview here.*

**I'd like to extend my thanks to Ms Ellie Thornton for her assistance in arranging my stay in Oxford and in making all the relevant course material available for scrutiny in good time. As per my comments last year, the MEng Materials Science degree scheme continues to provide the highest standard of education in the subject area by academic staff who are world leaders in their respective research areas.**

| | |
|---|---|
| **Signed:** | Geraint Williams |
| **Date:** | 15/7/2022 |

# Department of Materials Academic (Undergraduate) Committee

## RESPONSE TO EXAMINERS' REPORTS 2022

**Faculty of Materials**
**Department of Materials Academic Committee**

**Preliminary Examination in Materials**
**and**
**Honour School of Materials Science (MS) Parts I & II**

The External Examiners' reports, the Prelim and 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 provided to the Faculty of Materials.

**1. Summary of major points**

There were no major issues arising from the 2022 Examinations.

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

**MS Parts I & II: Professor Haynes**

As in previous years we thank Professor Haynes for his overall very positive report, constructive comments, and the time and effort devoted to his role over the past four years as an External Examiner, not least in the substantial task of examining the Part II MS theses.

In response to specific comments:

A concern was raised by Prof. Haynes regarding a perceived disconnect between the handling of requests for extensions and mitigating circumstances, with a recommendation that extension requests should be handled by the Department in the first instance. Our experience is that the impact of such extensions is only significant at Part II (i.e. the dissertation), in which case there are no other deadlines to conflict with. The examiners and assessors are fully aware when receiving the dissertation for assessment that an extension has been granted. Extensions can put some pressure on the assessment process, and our examination conventions state the "maximum extension that the examiners can accommodate for a Part II thesis to be examined in the 2022/2023 session is 14 days. Any extension awarded for longer shall mean the assessment will normally be considered by the scheduled examination board in the next academic year."

Prof. Haynes commented on the continued use of double-blind marking, its cost and benefits, and supported the move (in 22-23) by the Department of Materials from double-marking by two examiners to double-marking by examiner and assessor (course lecturer).

The FHS examiners have also asked Faculty to consider a further change to a ‘Marker plus checker’ model, where papers are single marked by the course lecturer and these marks are checked at an appropriate level, rather than full ‘double marking. DMAC will seek information on approaches in other departments and review the outcome of the 22-23 process. A proposal would be presented to Faculty for possible changes to be implemented in 23-24 at the earliest.

**MS Parts I & II: Professor Williams**

We thank Professor Williams for his very positive report, his thoughtful and constructive comments, and the time and effort devoted to his role as an External Examiner, not least in the substantial task of examining the Part II MS theses.

In response to specific comments:

Professor Williams commented on the possible provision of ‘best-practice’ for the assessors and examiners to reconcile discrepancies in their initial assessments of the Part II dissertations. He observed this occurred in dissertations that were first to be scrutinised by the assessor/examiner. The current marking guidelines provide the assessors with descriptors for the expected standard within the mark boundaries, and they will be reminded to review their assessments to ensure a balanced view is provided. Examiners and assessors of Part I examination papers will also be reminded of the requirement to use the provided mechanism to enter a justification for reconciled marks.

**3. Further Points**

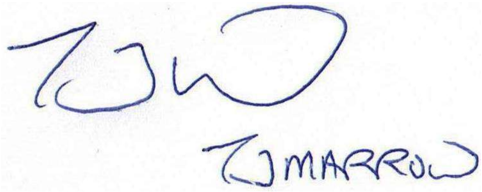
There are no concerns raised in the detailed reports of the internal examiners for the FHS on which we wish to comment, other than items raised above by one or both external examiners.

The Prelims moderators noted in their report “"The Moderators would like to put on record the wider point that the provision of MCEs after the board dates, MCEs with a lack of support from the college, and MCEs with no or insufficient medical evidence, make it increasingly difficult for an examination board to properly consider the impact of what may be very serious mitigating factors on the student performance. This is especially true when the MCEs only arrive after the formal results have been released.” DMAC notes that the Examinations and Assessment Framework states “It is the candidate’s responsibility to raise any issue that may have impacted on their performance, to complete a candidate statement, and to provide appropriate evidence in support” and that MC notices submitted by students are not necessarily received by colleges for review. Students at both Prelims and Part I are briefed by the Director of Undergraduate Studies on examination matter, including the procedure for submitting MC notices. The briefing presentation will be extended to emphasise the student responsibility. The DUGS will write to Senior Tutors at colleges to request them to be more proactive in the MCE process.

**4. Other matters on which departments are mandated to report to Division**

We confirm that the examiners held specific meetings to consider Mitigating Circumstances Notices.

We confirm that qualitative checks were carried out in respect of scaling, as stipulated in Section 3.4 of our FHS Exam Conventions.



T.J. Marrow, Chair of DMAC, 22/11/22