CONFIDENTIAL

EXAMINERS' REPORTS 2019
MATERIALS SCIENCE (MS)

Internal Examiners' Reports

REPORT ON PRELIMINARY EXAMINATION IN MATERIAL SCIENCE

Part I

A. STATISTICS

Category	Number			Percentage		
	2018/19	2017/18	2016/17	2018/19	2017/18	2016/17
Distinction	10	8	12	25	27	33
Pass	29	21	22	72.5	70	61
Fail	1*	1	2	2.5	3	6

* One candidate resat in September and passed on this occasion

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

B. NEW EXAMINING METHODS AND PROCEDURES

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 as well as improving familiarity prior to second marking.

As has been the practice in previous years, it was decided that it was not necessary to set questions on every 4-lecture course and that questions may require knowledge from more than one lecture course. This approach is directly in line with standard practice in Part I examinations. This follows the practice that was set last year. Lecturers are asked to suggest questions in order to avoid similarity of questions to previous years. 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 DIVISION BOARD TO CONSIDER.

<u>Materials Papers</u>

In 2018 the average mark for the MS2 paper was the lowest recorded in recent years, in comparison the 2019 average mark is the highest. This is likely a slight over-correction in the setting questions, so as to encourage the students to more fully engage with the material. The high MS2 marks are the reason for a small increase in the average mark over all three Materials papers in comparison to last year, despite the significant decrease in the average MS3 mark. Average marks are still considerably higher than for Finals and it is still the case that some questions did not extend the students enough. These more straightforward questions were again easily spotted by the candidates and were answered by large proportions of the cohort. In order to make Prelims examinations a more realistic indicator of Finals performance and more useful preparation for the students, it must be continued to be emphasised that every question should be assessed for how it extends the students beyond reproducing arguments and derivations given in the lectures or rehearsed in the tutorial questions/past exam papers. If it is not clear from the lecturer's worked solution and commentary which parts of the question fulfil this requirement, the Moderator should request this additional information from the lecturer in a timely manner. The aim is to have questions in the Materials papers that test basic knowledge with sections that are designed to challenge the students further and test their problem-solving skills.

It has been the case that some questions submitted by the lecturers needed modification because they were too predictable or because they contained some errors. However, the Moderators were pleased to note that most lecturers provided commentary alongside their worked answers, and demonstrated a strong willingness to further modify aspects of their questions and/or worked answers at the Moderators' request.

Maths Paper

The average mark on the Maths paper this year was 61.5% which is comparable to last year (60% in 2018). For the past two years Maths lecturers have been asked to introduce harder questions especially in section B of the paper in order to improve differentiation between students. This year the Maths paper has again proven to be a harder challenge for students, as emphasised by the Moderator's own comments in their report. Whilst it is good to challenge the students in this way, it is clear that the future moderators should be cautious in not to increase the difficulty significantly further.

Coursework Paper

The coursework paper is made up of 50% from the first year practicals, 25% from the crystallography classes and 25% from the new Computing for Materials Science course. (One returning student was examined in coursework comprised of 50% from the first year practicals and 50% from the crystallography classes.)

Computing for Materials Science (CMS)

The marks were reviewed and approved. This was the first year this course has been delivered, and wide distribution of marks was achieved. The Moderators are strongly supportive of the generous request for the assessor to be able to provide feedback to the candidates on their work.

Crystallography coursework

The report from the Senior Demonstrator flagged no specific concerns. Although, marks were lower than in the previous year, a fairly high mean mark was achieved. Given the nature of this coursework, working in groups in class, this result is understandable.

Practicals

The Moderators considered a report from the Practical Class 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 impact.

The Moderators endorsed the PCO's recommended penalties as laid out in their report. The Moderators note the significant amount of penalties for the late submission of work, and the fact that a significant proportion of these were accrued by a number of repeat offenders.

The Moderators considered three specific cases of Poor Academic Practice. These were all flagged by the University's plagiarism awareness software, Turnitin, which identified issues with originality of the submitted reports. Once identified, the flagged reports were assessed by both the relevant SD and then Chair of Prelims. They were all deemed to be, beyond reasonable doubt, cases of low-level plagiarism. The Moderators viewed this extremely seriously, and applied the maximum penalty available to them for each of these cases. The relevant candidates were also sent a formal letter of warning from the Chair and the Director of Studies to the Senior Tutor of the candidates' colleges, to be discussed in person upon their return to Oxford in Michaelmas term. The Moderators stress that plagiarism in any form is unacceptable.

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

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

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

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

40 students were registered for the examination.

37 candidates passed all papers, without the necessity for compensation, with 2 candidates being compensated in the MS3 paper. Of these 39 successful candidates in June, 10 were awarded Distinctions, all with marks of 75% or more (rounded). 1 candidate failed one paper, to be retaken in September.

There was a minor error in MS2 which had been detected in advance of the paper and an erratum notice had been issued. In addition, there was a minor error in the MS3 paper. However, this error was identified within the first few minutes of the examination and the correction announced by Moderator. Given that this was one on the most frequently attempted questions, and the question on which students achieved the highest average mark, it is apparent that this error did not negatively impact the examination.

The prize for the best overall performance in Prelims was awarded to Martin (Ingon) Kim, of St Anne's College. The prize for the best performance in 1st year Practicals was awarded to Adam Suttle of The Queen's College. Additional prizes for outstanding performance were awarded to Harry (Ziyi) Yuan of Corpus Christi College, and Louis Makower of The Queen's College.

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

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

Gender Issues:

Of the 40 candidates 16 were women and 24 men.

2 of the 10 distinctions were awarded to women.

In view of the small overall number of candidates, it is not sensible to draw conclusions from these data. The mean score for males was 68.3% and for females 68.9%.

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

All candidates took the same papers for the whole examination. Although it is noted that 1 returning student did not take CMS as part of the coursework assessment.

D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

Attached.

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

There were three applications to consider regarding Mitigating Circumstances: Notices to Examiners. [redacted]

[redacted]

Two medical certificates were received and considered by the Moderators when reviewing the final results, as shown in the table below. [redacted] There were also five applications for special arrangements for the written papers.

[redacted]

F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

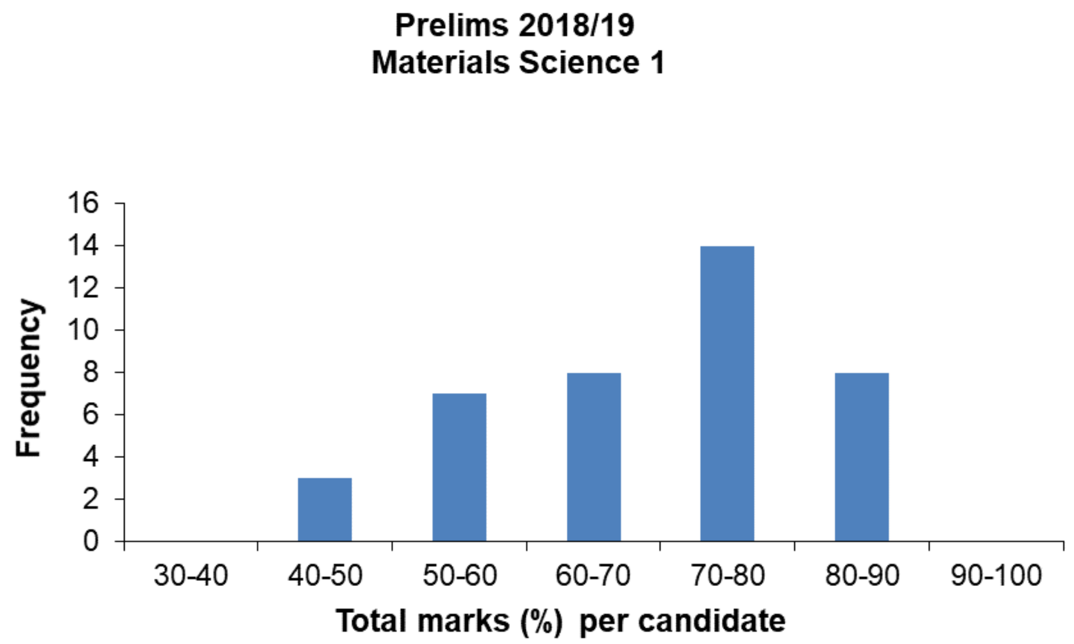
Professor F. Giustino
Professor M.P. Moody (Chair)
Professor K. Porfyrakis
Dr J.S.Kim

MS1 – Structure of Materials

Examiner: Professor Michael Moody
Candidates: 40
Mean mark: 70.06%
Maximum mark: 90%
Minimum mark: 44%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	34	15.41	19	9	Defects in Crystals
2	35	15.19	20	8	Metals and Alloys
3	35	14.66	20	9	Ceramics and Semiconductors
4	6	11.17	18	1	Polymers and Composites
5	24	14.96	20	4	Crystallography and Diffraction
6	21	11.86	18	4	Crystallography and Diffraction
7	22	13.86	19	8	Crystallography and Diffraction
8	23	11.04	17	3	Elementary Quantum Theory & Bonding



General comments:

The average mark was 70%, however a wide spread can be seen in the distribution with many students scoring significantly higher grades. Popular questions were Q2 and Q3, on the short lecture course on Ceramics and Semiconductors and Metals Alloys, respectively. These required knowledge of standard definitions and relatively straightforward derivations similar to problems encountered previously by the students and hence received high marks. The other very popular question was based on the Defects in Crystals lecture course, Q1. In particular, students were well prepared for the discussion on defect mediated diffusion in solids and hence high marks were also achieved for this question. The Polymers and Composites question, Q4 was unpopular again this year with only 6 attempts (less than the 9 attempts in 2018), despite the fact that this was seemingly a well-constructed, readily accessible question. As highlighted by previous moderators, this suggests that the students are still strategically avoiding learning this lecture course.

Specific Comments:

1) Defects in Crystals: This was a popular question, which was generally well answered by candidates. The definitions in Part a) were well addressed, with the exception of a “colour centre”. Part b) was well answered by most candidates with a good amount of detail in the explanations. However, considering the nature of Part c), it was surprising that most candidates did not mention the relative size of an atom when addressing the notion of substitutional or interstitial diffusion. Part d) had a mixed response. Of most concern was the lack of description that candidates provided to explain their steps in logic or calculations, given that the question explicitly requested this. Some candidates over-complicated their answers using derivations of Fick’s 1st Law, however, this was not necessary to obtain full marks in this instance.

2) Metals and Alloys: This was a very popular question, on which a high average mark was achieved. Part a) was well answered, however, the most common issues were in explaining that to be termed a “superlattice” there must exist a non-ordered form of the phase must exist. Further, the Laves phase was often not described well, and frequently no example was provided. In Part d), while not all octahedral sites were needed to be indicated to achieve full marks, many candidates highlighted the position of too few to given an indicative representation of their distribution. Many candidates were able to successfully calculate the radius-ratio of the tetrahedral holes in BCC iron, however, often students incorrectly assumed that the larger tetrahedral sites would be preferably occupied by carbon.

3) Ceramics and Semiconductors: This was another very popular question. Part a) was very well answered, with the exception i), in which candidates failed to identify that NiO was a mostly ionic compound. The biggest issue in addressing Part b), calculating the packing fraction of atoms within the diamond unit cell, was incorrectly identifying the relative coordinates of nearest atomic neighbours. The quality of response to Part c) was mixed, and there was significant confusion in sketching the energy diagram for doped silicon, and in its subsequent interpretation.

4) Polymers and Composites: This was by far the least popular question of the paper. However, it is not clear why more candidates did not attempt this question. The structure was reasonable, with a mix of knowledge from bookwork and a calculation in Part d) that was done well by most who attempted it. In Part a) many responses lacked specific examples of enhanced properties with respect to the original polymer. In Part b) the properties resulting from the microstructure polyacrylonitrile and mesophase pitch, respectively, were not well delineated. In Part c), for both the aerospace and sports-and-recreation industries, in each case candidates were asked to discuss two examples of the use of carbon-reinforced composites. In many cases, only one example from each industry was provided. Part d) was for the most part well done however responses often lacked clear explanation of the steps in logic in deriving the answer.

5) Crystallography: This was a well-answered questioned. In Part a) most candidates failed to mention the concept of long-range order in their explanations. Part b), the indexing of the first three crystal reflections using the presented diffraction pattern, was generally successfully attempted by candidates. The question explicitly asked for accompanying explanation as to the assignment of Miller indices, however, many responses lacked significant detail to support the calculations undertaken to come to this labelling. It was surprising that several candidates who attempted this question did not present the requested 2D plan of the FCC unit cell, and may

suggest that they did not fully read all parts of the question. Response to Part c) were of a mixed quality, many candidates mistakenly proposed a broadening of peaks instead of a shift in their measured positions in the diffraction spectra.

6) Crystallography: Candidates found identifying the unit cell of the 2D atomic distribution of graphene depicted in Part a) very challenging. Even those who correctly present the unit cell often did not correctly identify its symmetry. Many candidates demonstrated capability to derive the systematic absence condition for the diffract pattern from a face-centred cubic crystal in Part b). However, marks were lost by those who skipped too many steps in their derivation, and ultimately asserted the conditions rather than explicitly deriving them. An extension of this concept in Part c) was only done well by a few students. A practical way to commence this question would be too identify and list the coordinates of the Na and Cl ions, respectively that will contribute to the structure function calculation. Those candidates who took this approach found that a workable route to achieve the assigned task was more apparent.

7) Crystallography: In Part a) candidates who were able to clearly and logically describe and illustrate the steps in the process of constructing a stereogram were able to achieve full marks. However, the explanations provided by a significant number of candidates lacked clarity and made use of diagrams that were often too small for purpose or lacked annotation, which led to marks being lost. This was likewise for Part b). In Part c) often candidates could draw an accurate stereogram but failed to annotate the requested crystallographic directions. In Part d) there was some ambiguity with how the symmetry of the illustrated pentacene molecule could be interpreted. Hence, there was more than one reasonable definition of symmetry, defining the point group and underpinning the stereograms that could be presented to achieve full marks in this section.

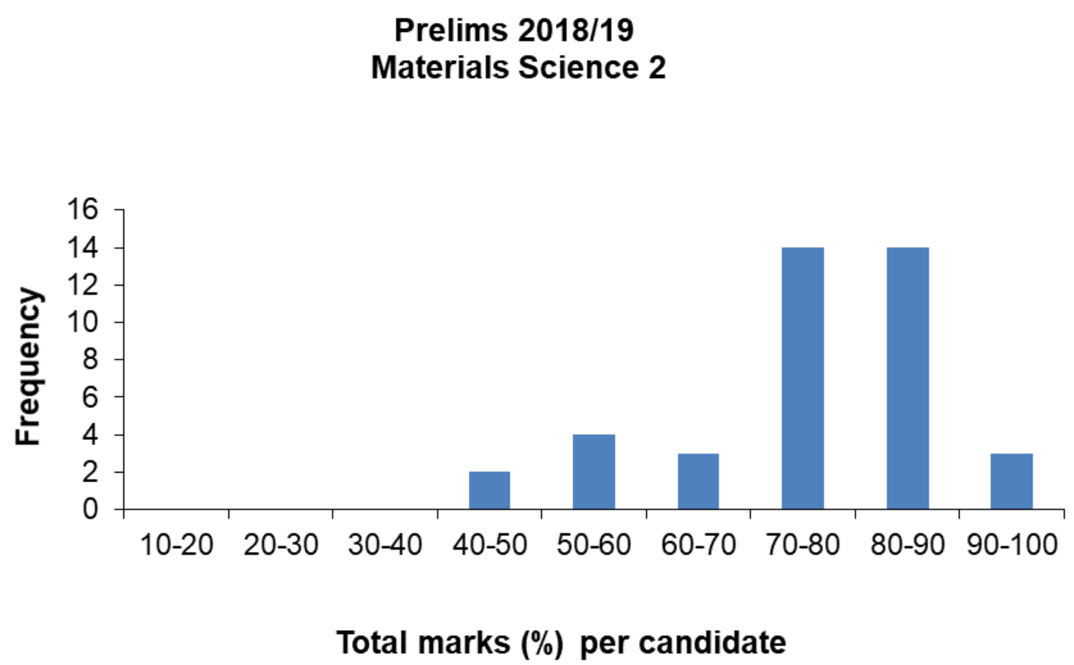
8) Elementary Quantum Theory and Bonding: Overall candidates found this question challenging. Many of those who attempted the question were able to do Part a) i – ii to a good standard, however, struggled with drawing the wavefunction subject to a finite potential outside of the box, particularly when n = 2. Many found the concept proposed in Part d) confusing, however, numerous candidates demonstrated a good understanding of what was required, but often made one or more incorrect assertions. A recurring issue was apparent in the definition of the energy level transitions and the dimensions of the “box.” For excitation of the molecule with two double bonds, i.e. 4 electrons associated to double bonds, this is an n=2 to n=3 transition, and the length of the “box” is $3a_0$ where a_0 is the length of a C-C bond. If a third double bond is introduced, there are now 6 electrons, so this an n=3 to n=4 transition and the length of the “box” is now $5a_0$.

MS2 – Properties of Materials

Examiner(s): **Dr Judy Kim**
Candidates: **40**
Mean mark: **76.39%**
Maximum mark: **92%**
Minimum mark: **47.5%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	33	16.13	19.5	10.75	Mechanical Properties
2	3	17.42	18.75	14.75	Electrical & Magnetic Properties
3	5	12.00	17	2.25	Electrical & Magnetic Properties
4	36	18.14	20	13	Kinetic Theory of Gases
5	32	12.57	19	3	Elasticity & Structures
6	39	13.19	20	5.5	Elasticity & Structures
7	35	17.27	20	9	Mechanical Properties
8	17	13.94	18.5	7	Mechanical Properties



General comments:

The mean mark for this MS2 paper at 76.39% was high compared to previous years with a small variance where 28/40 candidates scored between 70-90%. A select few showed that they only adequately knew the examinable material, as well as a few that distinguished themselves with very high marks. This did not reflect the distribution of candidate performance well due to the option to answer only five out of eight questions.

Questions 1, 5, 6 and 7 were most popularly attempted which were all covering topics in Elasticity and Mechanical Properties. The Kinetic Theory of Gasses question (No. 4) was also very popular with candidates. Some of the highest average marks were achieved from questions which required a long derivation to a solution that was given in the question (4 and 7). The two Electricity and Magnetism questions were answered only eight times in total; however, the average marks were in line with those of other questions.

Specific Comments:

9) A very popular question for candidates on stress-strain curves. Most were able to draw reasonable curves; however, zero correctly showed $E_{Cu} > E_{glass}$ at the linear elastic portion of the plot. The approximate values for E and $\sigma_{failure}$ included much guess work, but the trend of which material had a higher value than the others was correctly understood. Some could not understand what was meant by “state Schimid’s Law in words” and instead described the variables of the equation. Calculation of slip planes were generally executed very well using Diehl’s Rule.

10) The few candidates who attempted this Gauss’ law electrostatics question received very high marks and appeared to truly understand the material even if the final numerical answers were not always correct.

11) This unpopular question in electricity and magnetism using Biot-Savart law for the magnetic field in a looped wire required an understanding of the physical orientation of *I* and *B*. This was correctly sketched; however, some candidates became lost in the trig identity simplification steps. Others made the false assumption that length = ∞, rather than a finite length, L. Those that attempted the final part of the question on the force generated by the various parts of the loop did well.

12) Candidates were able to reliably replicate the proofs to generate Clausius’ equation of state, van der Waal’s equation of state and the flux of gas molecules against a container wall. These topics may have been covered very carefully in lectures and were perhaps missing the element of new or applied knowledge that would have made a larger distribution of marks. Some candidates lost marks for not showing reasoning and making large jumps to memorised equations.

13) Many candidates attempted this question based on the load applied to a cantilever and showed good comprehension of the material in the first half which required the determination of forces and moments. The later portion which required derivation beginning from the given radius of curvature equation was not completed by all, but those who did understood the necessary steps well.

14) This question using Mohr’s circle to find stress and strain states was attempted by all but one candidate, yet the average mark was not very high. Circle construction and stresses were generally calculated correctly. When calculating strain there were more errors as some appeared to confuse ε_{xx} and ε_{yy} with ε_{11} and ε_{22} causing a misuse of Hooke’s law. Others did not think to find ε_{zz} as well.

15) Candidates commonly attempted this question which included the derivation of the Griffith equation of tensile stress for fracture. The derivation may have been memorised from lectures as some did not even show the integration steps to achieve the final solution. The simple description of toughness and strength caused a few to become confused, as perhaps it was quite an open and broad question. Likewise in another essay-type portion of the question on toughness and strength of specific composite materials, candidates generated a wide variation in answers allowing one to see their confusion or comprehension.

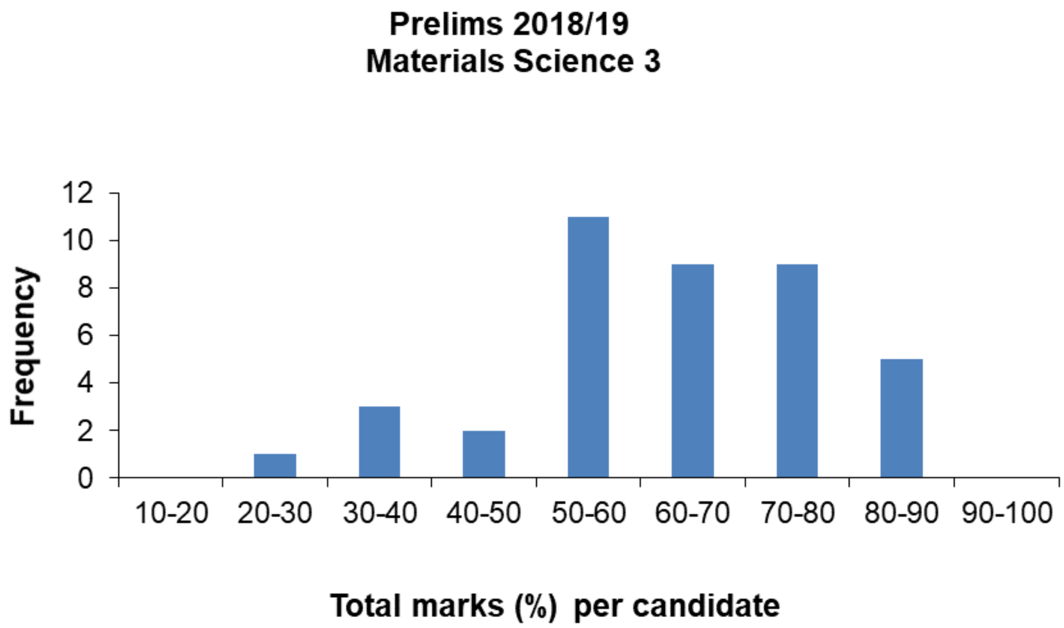
16) The final question on mechanical properties and processing was answered by less than half of candidates. This may simply have to do with its placement at the end of the exam, however many were missing key elements of the required solutions. Yield stress varying with composition curves were generally sketched correctly, but often without any numbers or estimated scale, thus, not displaying the main point that one system had a large difference and another had a small difference with varying composition. When asked to describe a heat treatment, there were many mistakes and only one candidate described the microstructure as requested.

MS3 – Transforming Materials

Examiner(s): Professor Kyriakos Porfyrakis
Candidates: 40
Mean mark: 63.45%
Maximum mark: 88%
Minimum mark: 26%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	19	8.16	18	1	Thermodynamics
2	32	15.47	20	4	Thermodynamics
3	36	13.14	20	1	Thermodynamics
4	33	13.85	19	8	Polymer Synthesis
5	6	4.50	9	0	Reaction Kinetics
6	29	12.72	19	1	Microstructures
7	13	11.46	19	2	Microstructures
8	32	12.91	20	4	Microstructures



General Comments

This was the lowest scoring paper of all the Prelims papers with generally lower marks than last year. Few students scored high marks. There was a rather large spread of marks from 26% all the way up to 88%. The average value is around the 63.5% mark. It is pleasing to see that all questions were attempted by at least 6 or more students. The students' performance seems to follow a "two-group" pattern. A small group of students performed badly scoring less than 50%, while the majority of the students scored more than 50%. The frequency distribution of marks shows that the paper did well in terms of achieving differentiation between students.

Specific Comments

17) This question on thermodynamics was not very popular. Less than half of the students attempted it. Generally, the students struggled with it. Most failed to plot the Ellingham diagram and to address properly the subsequent parts of the question.

18) This was a reasonably popular question on thermodynamics. The students coped well with it. They managed to get the highest average mark compared to all other questions. The question covered a broad range of aspects of the laws of thermodynamics. Many students got the part of Henry's law question right, which is good as they transferred knowledge from the 1st year practicals too.

19) This was the most popular question. It was on thermodynamics. The students generally coped well with the question managing to perform the calculations on Gibbs free energy and on entropy. There was a good spread of marks on the question.

20) This was the second most popular question and got the second highest average mark. It was on polymer synthesis. Generally, some students struggled with the first part of the question involving the reaction mechanism of polystyrene, while most students coped well with the second part of the question involving molecular weight calculations.

21) This was by far the least popular question. It was on reaction kinetics. Very few students attempted it and with little success overall. This is somewhat odd, as a similar question in last year's paper was a very popular question. However, this follows a trend from last year; it seems that the students generally struggle with reaction kinetics and the relevant calculations involving Arrhenius parameters.

22) This was a reasonably popular question on microstructures. The students did generally well in the first half of the question involving the graphical description of solid-solid interfaces. The second half of the question involving the description of composition profiles under interface and diffusion control was harder for the students to answer correctly.

23) This was a rather unpopular question on microstructures. The students generally struggled with it. This was a question asking the students to describe 3 different characterization techniques using schematic diagrams. The students coped relatively well with the optical microscopy but not so well with scanning electron microscopy and with the atom probe.

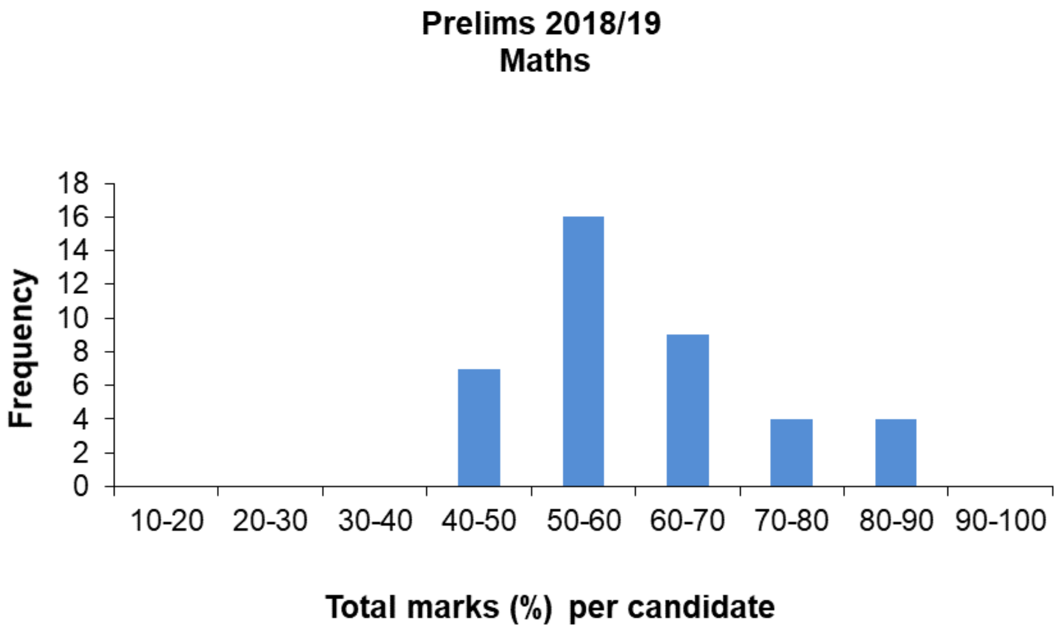
    This was a "classic" microstructures question on phase diagrams. It was reasonably popular with a wide range of marks achieved. The first part of the question was quite popular and the students did mostly well in describing the eutectic phase diagram with two components. The latter part of the question was harder and the students found it demanding to sketch the free energy-composition curves at different temperatures.

Mathematics for Materials Science

Examiner(s): **Professor Feliciano Giustino**
Candidates: **40**
Mean mark: **61.15%**
Maximum mark: **87%**
Minimum mark: **41%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark
1	40	6.03	8	0
2	40	6.83	8	2
3	40	4.08	8	0
4	40	4.38	8	0
5	40	3.11	8	0
6	40	2.70	8	0
7	40	6.75	8	1
8	40	6.08	8	2
9	40	7.06	8	0
10	40	6.35	8	1
11	38	18.63	25	0
12	16	10.38	25	0
13	21	11.33	22	2
14	19	13.53	25	0
15	37	17.46	24	4
16	23	9.78	16	0



General comments:

The average mark was 61%, slightly higher than last year but significantly lower than the 2017 peak of 80%. This outcome is in line with the decision to make the maths paper more challenging in order to better align with the results of the finals. Standard questions were answered by most students, while all those parts that are not standard bookwork were mostly left unanswered. The worst performance is observed for Q5 on complex roots, Q6 on power series, Q12 on inexact differentials, and the part of Q16 on the method of variation of parameters. For these questions most students did not seem to know how to approach the problem. On the other hand, the most popular/well answered questions were those on matrices and determinants, geometry, and deformations of solids. The exam paper was free of errors and no questions were raised in relation to the paper during or after the examination. There has been one question regarding an inconsistency in the front page. In the front page it is stated that the student has to answer 5 questions, but in the paper it is stated that they must solve 10 questions from Part A and 4 from Part B. This is likely due to the fact that the front page is common to all papers. The students were immediately told to answer 10+4 questions so this is inconsequential, but for next year it would be good to update the front page.
Overall this exam appeared rather challenging, and the level of maths required appears higher than what we generally see in courses of the second and third year.

Specific Comments:

1) Average: 75%
Standard question on the evaluation of partial derivatives, fairly straightforward. Most students were able to provide correct answers.

2) Averages: 91% (a), 79% (b)
Standard question about the stationary points of a cubic function. The question requires evaluating first and second derivatives and sketching the function. Most students answered correctly.

3) Averages: 95% (a), 41% (b)
Question about trigonometric functions and the Euler relation. Nearly all students managed to answer part (a), which is simply about rewriting the tangent in terms of complex exponentials. Part (b) is not standard bookwork and requires some algebraic manipulations. Most student performed some initial substitutions but could not identify a path to reach the required expression.

4) Averages: 38% (a), 65% (b)
Question on the indefinite integral of trigonometric functions. Many students performed a correct but ineffective substitutions in part (a), and as a result did not succeed in evaluating the integral. Part (b) was a standard integration by part and most students performed the correct steps, albeit with several small errors along the way.

5) Averages: 49% (a), 25% (b), 18% (c)
Question on complex roots and the Argand diagram. Most students did not know how to proceed, and provided only partial answers. Only in a couple of cases we have complete correct answers. Students do not seem to be familiar with this topic.

6) Averages: 36% (a), 26% (b)
This question requires to find the power series of a function. In order to solve this problem one has to recognise that the function contains an inverse hyperbolic tangent, and the power series of the derivative of the inverse hyperbolic tangent is well known. Therefore the required steps are derivative, power series, and integration. Very few students succeeded in completing this procedure. Many students started evaluating the series by evaluating successive derivatives explicitly. Part (b) on the convergence limits of the series was left unanswered by many.

7) Averages: 82% (a), 86% (b)
   Question on evaluating the limit of a fraction using first the rule of L'Hopital and then a power series. The students appeared very familiar with this problem and most answers were correct.

8) Averages: 92% (a), 59% (b)
   Question on reciprocal lattice vectors and their scalar products. Most students were able to find the reciprocal vectors correctly in part (a). In part (b) several students tried to solve a matrix equation as opposed to simply use the fact that reciprocal lattice vectors are orthogonal to direct lattice vectors.

9) Averages: 89% (a), 94% (b), 90% (c), 71% (d)
   Question on matrices describing shear deformations. All parts were well answered by most students.

10) Averages: 79%
    Question on finding the inverse of a 3x3 matrix. Nearly all students answered correctly, barring some small calculation errors.

11) Attempts: 95%, Averages: 97% (a), 97% (b), 62% (c), 55% (d)
    Popular question about the chain rule for a function of two real variables. The question is straightforward and requires some algebraic manipulations. The low scores are mostly related to small errors in the derivations. Probably this question was chosen by most as it is relatively easy.

12) Attempts: 38%, Averages: 47% (a), 47% (b), 43% (c), 34% (d)
    Question on inexact differentials. The attempt rate is low, and most students struggled to complete the derivations. Students did not seem to be familiar with this topic, and did not know how to proceed.

13) Attempts: 50%, Averages: 66% (a), 58% (b), 31% (c), 16% (d)
    Question on the moment of inertia of cylinders. Most students managed to evaluate the moment of inertia of the full cylinder and the hollow cylinder, while the core/shell cylinder proved more challenging. Most students were not aware of the relation between linear velocity of the cylinder and the angular velocity, but realised that the velocity at the bottom of the slope is related to the moment of inertia. The impression is that students were able to answer those parts of the question that they already have seen in the lecture course, and struggled with the less standard parts.

14) Attempts: 48%, Averages: 89% (a), 88% (b), 79% (c.i), 83% (c.ii), 49% (d), 16% (e), 16% (f)
    Question on the intersection of spheres. Most students managed to answer correctly the parts involving two spheres. The later parts of the question, involving three spheres, proved more challenging.

15) Attempts: 93%, Averages: 97% (a), 89% (b), 30% (c), 79% (d), 64% (e), 64% (f)
    Popular question on eigenvalues and eigenvectors of a 3x3 matrix. Most students managed to find the eigenvalues and eigenvectors. Part (c) on finding the conditions under which the eigenvalues are all non-degenerate appeared to be more challenging.

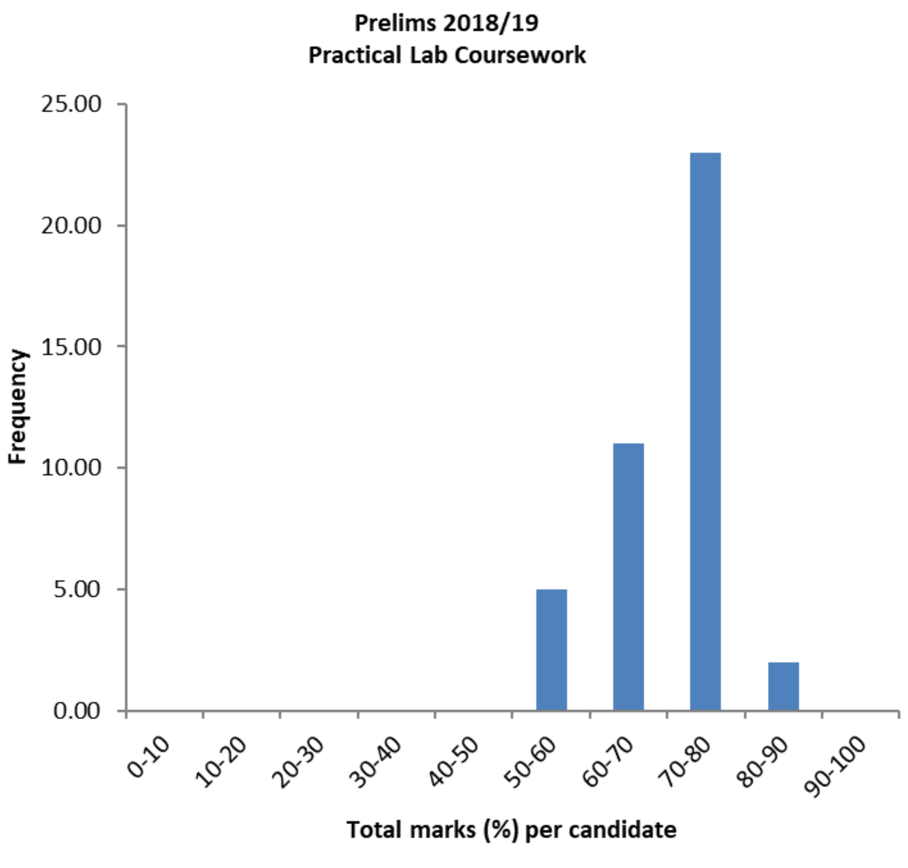
16) Attempts: 57%, Averages: 73% (a), 43% (b), 3% (c)
    Question on the differential equation describing an RLC circuit. Barring small errors, most students were able to find the solution for the homogenous case. The inhomogeneous case in part (c) was not answered correctly by anyone. Students do not appear familiar with how to use the method of variation of parameters.

Practical Lab Coursework

Candidates: 40
Mean mark: 70.2%
Maximum mark: 83%
Minimum mark: 53%

Detailed comments on the coursework are as follows:

Lab No	Average Mark	Highest Mark	Lowest Mark
1P2	6.53	8.00	0.00
1P3	8.28	10.00	5.00
1P4	6.69	8.50	5.50
1P5	6.99	8.80	5.00
1P6	6.43	9.00	3.50
1P7	6.10	8.30	3.30
1P8	8.18	10.00	5.50



Report from the Practical Class Organiser for 1st year Practicals 2018-19

I have reviewed the marks from the 1st year Practicals 2018-19. There is a very broad range of overall average marks ranging from 54 to 82%. The range of marks for an individual practical vary from practical to practical, with most practicals having over 10% spread and 1P2 and 1P5 having the narrowest at 8%.

Gender: I have assessed the marks for gender imbalance by looking to see who has received the highest and lowest marks for each practical and have not found any evidence of bias. Both genders got the same average marks within 1%.

Penalties: I have looked at the suggested penalties and am recommending that these are accepted in their entirety. There is one student whose work was submitted 9 weeks after the start of practical and a mark of 0 is proposed.

Plagiarism: This is the first year that the University's plagiarism software Turnitin has had previous years reports in its database. There have been 3 cases of suspected plagiarism, reported by the SDs after looking into the Turnitin reports provided for each practical (provided to the examiners as an appendix of this report). It should be noted that two of these cases concern the same student. SDs were asked to mark the reports as if there was no plagiarism.

Problems which occurred in the labs during the course of the year which the Moderators should be aware of as potentially affecting candidates' marks: there have been a number of issues which have impacted the practicals this year:

(i) 1P9. This year one of the SDs for 1P9 was ill and feedback sessions were delayed. All subsequent practicals and related workshops were delayed accordingly and I believe the impact on the students' ability to learn from feedback on their write-ups and hence to improve their performance was minimal. In any case, since all the students underwent the same delays, they were equally impacted.

(ii) 1P6. Despite our efforts and multiple trials before the practicals, also this year a higher than usual number of the glass test-tubes that contained the metal alloys used in the 1P6 practical broke and so further data collection was not possible. Where necessary, alternative data-sets were provided to the students who could then use these for their write-ups. They were therefore not disadvantaged. The SD was aware of the situation. A different type of test tube (stainless steel) will be tested over the summer, hopefully fixing this problem permanently.

(iii) 1P3. There were equipment problems regarding Cd Electrochemical cell experiment on the first day of the practical. The SD provided them with the reference data so they could complete the calculations and report.

(iv) 1P7. One group in accidentally unticked "load" as well as the other pre-set parameters on the tensometer software which meant they did not have data and they had to use another groups'. SD was aware and took this into account when marking.

(v) 1P4. The second week's groups all struggled to achieve a signal >100mV for the hydrogen spectrum and spent (and wasted) a lot of time on this. All groups just managed to finish but rushed part 2 of the practical (the emission and absorption spectrums of white and blue LED's). SD was aware.

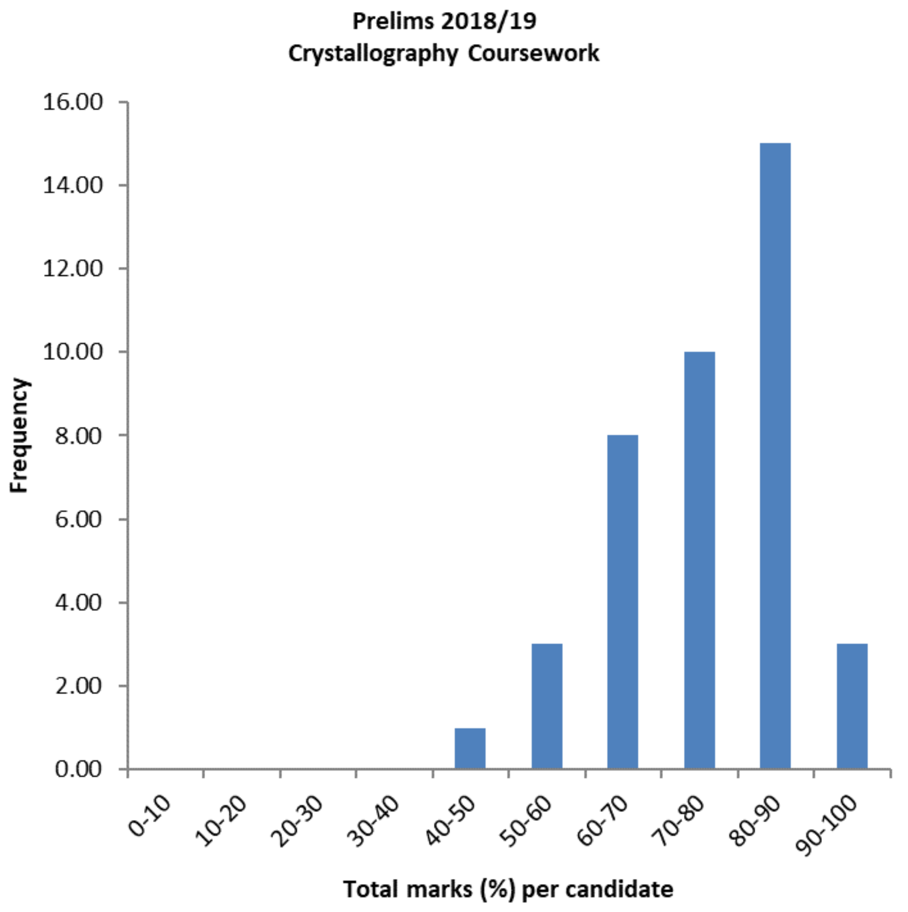
Practical Class Organiser – Sergio Lozano-Perez
June 2019

Crystallography Class Coursework

Candidates: **30**
Mean mark: **85%**
Maximum mark: **92%**
Minimum mark: **66%**

Detailed comments on the coursework are as follows:

Demo No	Average Mark	Highest Mark	Lowest Mark
D2	7.7	10	5.0
D3	7.9	10	3.5
D4	7.6	10	3.5
D5	7.8	9.0	5.5
D6	6.3	9.0	3.0



Report from the 1st year Crystallography Class Organiser for 2018-19

The large majority achieved good marks in the classes, with a final average grade of 76% across the year group. Most students scored a final grade between 60 to 90%, with three scoring an average of over 90%, and three scoring between 40 to 60%. There were no recorded absentees for any of the classes, so no correction was necessary to account for this. For context, last year the marks ranged from 6.5 to 9.3, with a mean of 8.4

Each practical is worth 10 marks, and a half mark is removed for each error so that a maximum mark of 10 is possible. The guided nature of the class, along with the availability of lecture notes and textbooks, means a score of 7 or below (6 or more mistakes) on any one practical indicates that the student struggled with that practical. The nature of the class material means that any student with a disability that may inhibit spatial perception or spatial reasoning will likely struggle. Special consideration should be accorded to their marks in such cases.

This year the class has changed, with the number of classes being cut in half. The remaining individual classes have remained broadly similar to previous years however, with six of the original 12 classes being removed rather than new classes being devised. The final class proved the most challenging, and showed the broadest range of marks.

Alex Robertson
Crystallography Class Organiser
2018-19

Examination Conventions 2018/19
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 2018-19. 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: http://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 Prelims paper on Maths for Materials Science 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.

Coursework paper

The Coursework Paper comprises three elements of coursework: a set of seven reports of practical work as specified in the MS Prelims Handbook (normally each individual report within the set has been marked already as the laboratory course progresses); a set of reports for crystallography (completed under the class schedule); and project work for Computing in Materials Science.

[*] for the 2018-19 examinations the Nominating Committee comprised Prof Grant, Prof Marrow & Dr Taylor.

For formal submission of the practical coursework, the Examination Regulations stipulate that candidates are required to submit the Materials Practical Class reports 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 Materials 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 examination. SMP tables are provided in all Preliminary examinations.

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.

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 their 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 the cover slip is not completed 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 Course 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 Course Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions.); 2. A set of seven 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. Project work for the Computing in Materials Science as specified in the Course 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 2018/19 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 14.9. 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 14.9 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 14.10. In the case of submission on the prescribed day for the submission but after the prescribed time on that day for the submission and without prior permission from the Proctors: 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, taking into account any circumstances communicated to the moderators by the Proctors should they approve a request by the candidate, submitted to the Proctors via the Senior Tutor of their college within five working days of notification of non-submission, that the moderators take into account the circumstances of the late submission.

(c) Under para 14.11. In the case of submission 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%.

(d) Under Para 14.12. 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 the Preliminary Examination as a whole, as stated in the Special Regulations for the Preliminary Examination in Materials Science.

Where an element of coursework is not submitted or is proffered more than 14 days after notification of non-submission 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 element of coursework in question (i) the Moderators will award a mark of zero and (ii) dispensation will be granted from the Regulation that requires a minimum mark of 40% if the candidate is not to fail the examination as a whole.

<u>Elements of coursework comprising more than one individual piece of assessed coursework</u>

Penalties for late submission of individual practical reports and individual crystallography class reports are set out in the 2018/19 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 9.6 and 10 of the 2018/19 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. 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).

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.

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.

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.]

Where a candidate or candidates have made a submission, under Part 13 of the Regulations for Conduct of University Examinations, 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 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 *Policy and Guidance for examiners, Annex C* and information for students is provided at www.ox.ac.uk/students/academic/exams/guidance. 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 2018 are: Prof. Feliciano Giustino, Prof. Judy Kim, Prof Michael Moody (Chair) and Prof. Kyriakos Porfyrakis. 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 2019:

Component	Mark
Materials Science 1: Structure of Materials	100
Materials Science 2: 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		
	2018/19	2017/18	2016/17	2018/19	2017/18	2016/17
Distinction	n/a	n/a	n/a	n/a	n/a	n/a
Pass	33	32	28	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

There were no new procedures or examining methods introduced this year.

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

The current procedure is that for the four general papers the lecturers propose draft questions to the examiners, but the papers are marked by the examiners only (2 examiners per paper, double blind). In contrast the two option papers are marked by the lecturer and by one examiner (again double blind). The Chair feels that the department should consider whether all exam papers should be marked by the lecturer and an examiner. There will be some administrative cost to adapting this model. However, this new approach will allow for feedback to the lecturers on the performance of students and student outcomes.

D. EXAMINATION CONVENTIONS

The current year's Conventions were put on the Departmental website and sent electronically, along with other information in a letter from the Chair of Examiners to all candidates on 1 March 2019. The Examination Conventions were agreed by the Board of Examiners and the Department's Academic Committee.

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

There were 33 candidates for the examination, all of whom were awarded Honours. 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 2nd year. Five candidates opted to take a supplementary subject; six candidates opted to take the Foreign Language Option. These replaced the business plan. In addition, candidates completed further coursework in the 3rd year in the form of either a module on Materials Characterisation (seven candidates) or one on Materials Modelling (twenty-five 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.

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, but, after consideration of the candidates, this was not applied by the examiners this year for any of the candidates.

The Business Plans, submitted in the second year, were marked by an Assessor from the Knowledge Exchange and Impact Team of Research Services 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 further examined a number of representative scripts from both modules, but felt that no further moderation of marks was necessary.

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

The overall mean mark for Part I was at the top end of the 2(i) band. All general papers and option papers results were considered. GP3 and OP2 were in the middle of the 2(i) band, with GP1 and OP1 at the top of the 2(i) band. GP2 and GP4 were both in the low to mid-range of the 1st class band. After extensive deliberation, and in accordance with the Conventions, the examiners decided that papers GP2 and GP4 should be scaled downwards to reflect that some of the questions on these papers were not sufficiently stretching to the candidates. Noting that the level of the more basic parts of the questions was appropriate, the examiners concluded that a percentage reduction scaling would be the fairest approach, resulting in an appropriately smaller reduction in terms of absolute marks for those candidate with the lowest marks. Consequently, a factor of x0.95 was applied to the results for GP2 and a factor of 0.93 was applied to the results for GP4. The examiners were careful to consider the impact of such action on each individual candidate, including scrutiny at the borderlines.

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 69.38%, F 65.00% (Overall 67.22%)
Coursework Averages – M 72.30%, F 72.48% (Overall 72.33%)
Overall Part I Averages – M 69.85%, F 66.87% (Overall 69.31%)

Insofar as can be judged from the small sample size, the performance of male and female candidates was not significantly different. This statement is based on the standard deviation of the written paper averages, which was ±12.3% points for the male candidates and ±9.89% points for the female candidates. Both male and female groups of candidates performed better in the coursework than in written examinations.

	Overall mark		Written Examinations		Coursework	
mark (%)	Male	Female	Male	Female	Male	Female
30-40	-	-	1	-	-	-
40–50	1	-	1	1	-	-
50–60	3	1	3	2	1	2
60–70	9	3	7	3	13	2
70–80	12	1	12	2	9	1
80–90	2	1	3	1	-	1
Totals	27	6	23	9	27	6

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

All candidates took the same papers for the whole examination, in that there were no optional written papers. Two candidates who were returning from suspension sat different versions of the two Options Papers to reflect the change in structure of the Options courses from when they attended lectures.

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

Seven applications for consideration of Mitigating Circumstances: Notices to Examiners were received, and medical certificates for a further three candidates relating to practicals were also received; all were considered by the examiners. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

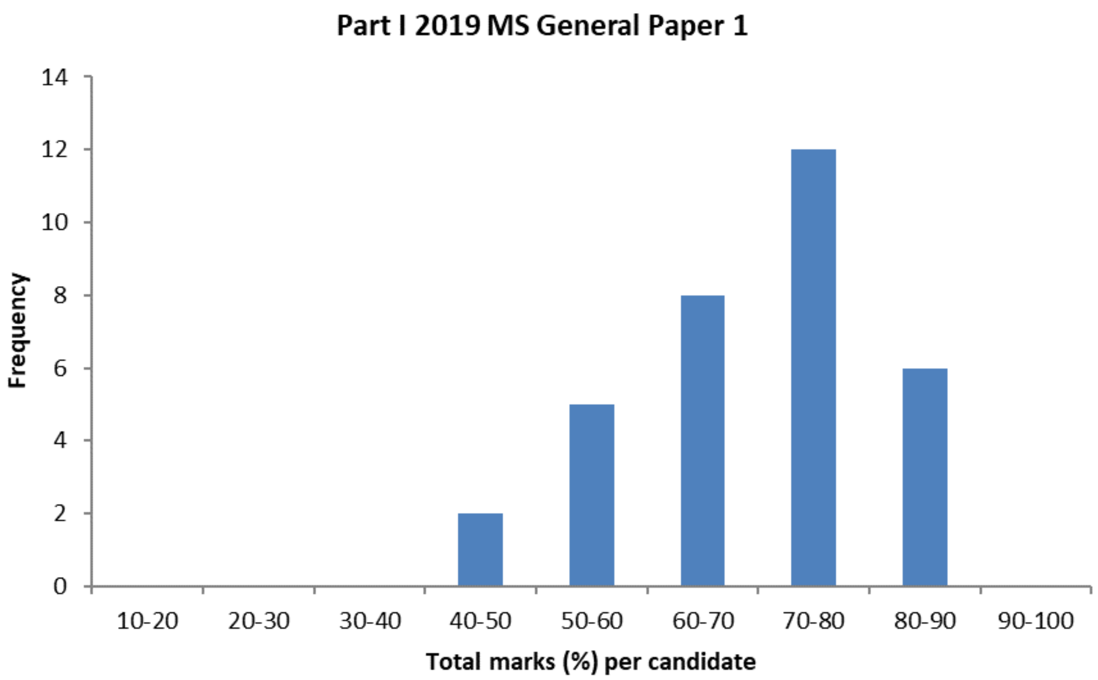
Prof. S.C. Benjamin	Prof. M.R. Castell
Prof. K.A.Q. O'Reilly	Prof. R.C. Reed (Chair)
Prof. A.J. Wilkinson	Prof. J.R. Yates
Prof. A.J. Davenport (external)	Prof. P.D. Haynes (external)

General Paper 1 – Structure and Transformations

Examiner: Professor Jonathan Yates
Candidates: 33
Mean mark: 69.18%
Maximum mark: 83%
Minimum mark: 45%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	19	13.84	18.5	5.5	Polymer Synthesis
2	16	10.47	15.5	6	Phase Transformations
3	20	13.53	19.5	3.5	Phase Transformations
4	26	15.40	20	9.5	Surfaces and Interfaces
5	17	15.29	18.5	11.5	Diffusion
6	16	14.94	17	11.5	Ternary Phase Diagrams
7	25	12.72	16.5	8	Corrosion
8	26	13.62	17.5	8.5	Corrosion



General Comments

The average mark on this paper was noticeably higher than in previous years. There were a number of questions that were either mostly bookwork or closely related to tutorial questions [1, 4, 5, 6]. Candidates were clearly well prepared to answer such questions, and the marks on these questions brought up the overall average compared to previous years.

Specific Comments

1) Most candidates could write something on this topic and earned a base level of marks. Strong candidates were differentiated by their in-depth knowledge and correspondingly detailed answers.

2) Most candidates could describe eutectic and eutectoid reactions in the first part of the question. However, the identification of the four microstructure was poorly done with most candidates earning few marks on this section – and none obtaining full marks.

3) The derivation of the Avrami equations was well done. The rest of the question attracted a full range of answers, and this question produces a good distribution of marks.

4) This was a popular question and attracted high marks. This was helped by the way in which the question was broken down into several small parts. The first half of the question was not very challenging, and most candidates provided complete answers, ensuring that all candidates score above half marks.

5) Answered by only half of the cohort – however, those that did demonstrated a good understanding of the topic.

6) Similar profile to questions (5) with typically competent answers from the half of the cohort who attempted the question. Unsurprisingly (given question 2) almost no candidates could draw the microstructure in the last part of the question.

7) A creative and interesting question on corrosion. Although the calculation was quite straight-forward almost no candidate could read the graph supplied to obtain the correct change in potential, and hence obtain the ionic resistivity of the paint. In answering the last part of the question many candidates ignored the practical constraints of the task – e.g. that it would be difficult to remove all the pipes from the submarine.

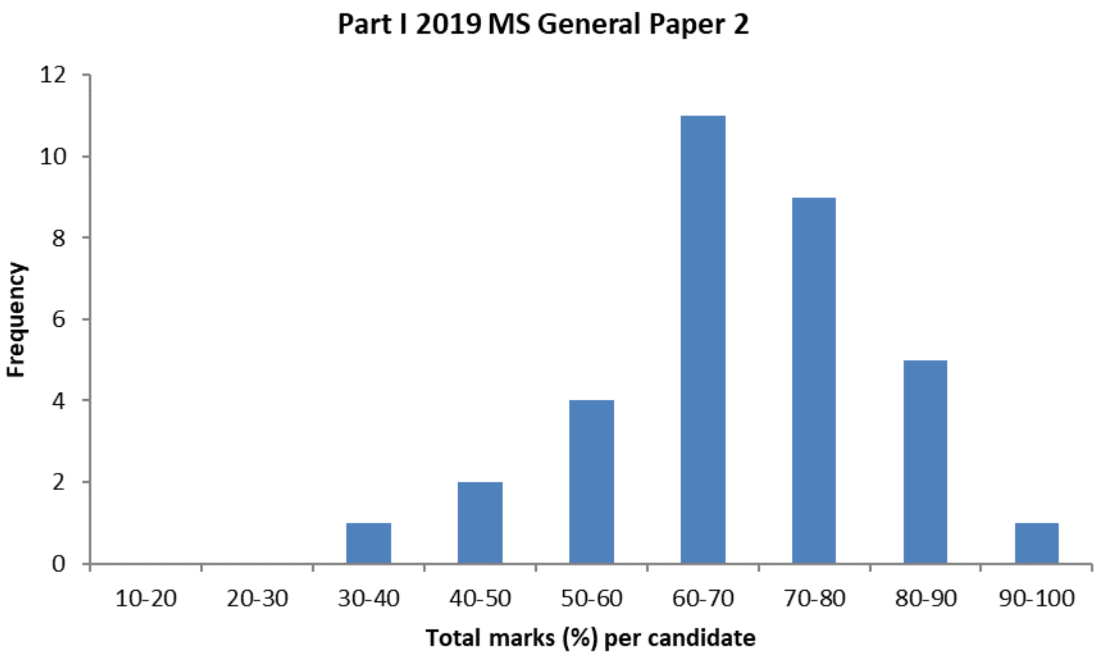
8) This was a more bookwork-based corrosion question. Most candidates could produce reasonable descriptions of Evans and Pourbaix diagrams, but only a few could recall the Fe and Cu Pourbaix diagrams in order to answer the final section.

General Paper 2 – Electronic Properties of Materials

Examiner: **Professor Simon Benjamin**
Candidates: **33**
Mean mark: **68.91%**
Maximum mark: **92%**
Minimum mark: **32%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	29	15.45	19.5	6	Semiconductor Materials
2	28	15.98	20	3.5	Electrical & Optical Properties
3	22	12.23	19	6.5	Quantum & Statistical Mechanics
4	10	11.10	16	8	Quantum & Statistical Mechanics
5	27	14.81	20	3	Magnetic Properties
6	25	16.22	19.5	10	Tensor Properties of Materials
7	7	11.14	19.5	3	Electronic Structure of Materials
8	17	16.32	20	6.5	Electronic Structure of Materials



General Comments

The paper was generally very well answered, to the extent that the uncorrected mean mark was above 70% and consequently a systematic percentage scaling was applied to all marks.

Generally the quality of the answers indicated that the majority of students had understood the work well and had revised the course contents thoroughly. However there were indications that the questions typically lacked sufficient content (and mark weight) in 'stretch' material that would force even a well-prepared student to think 'on their feet' to use their knowledge in a not-before-seen element. A recommendation for next year's paper is that all questions should be evaluated for this criterion specifically.

The two most popular questions were the first two, which concerned the free electron gas (Fermi surface/vector etc) and the electronic structure of graphene; these questions had 29 and 28 attempts respectively. The least popular were question 7, with 7 attempts, which concerned electrical breakdown in solid insulating materials and had a strong written component, and question 4 on quantum theory with 10 attempts, which again had a significant component of explanation/discussion.

The questions were double marked (blind) by the setters Simon Benjamin and Martin Castell.

Specific Comments

1) The most popular of the questions, with only ~3 students opting not to take the question. Part (b) several students wrote, and then 'solved', d/d**r** i.e. vector **r**, instead of showing that they understood they are solving DelSquared psi = E psi. Definitions of Fermi energy, wavevector, surface, all generally well understood. The nature of Fermi surface was well understood for 3D, 2D, usually 1D but several students opted for "the whole line" rather than two points. Some students described the surface as encompassing only the positive octant (for 3D) or quadrant (for 2D) of k space. The last two parts generally well done, but it is worth noting that for (f) many students wrote N(E_f) and differentiated with respect to E_f rather than considering explicitly the integral that would yield N(E_f) – acceptable but not ideal.
2) A popular question; those answering it had obviously revised the topic and were able to reproduce roughly the correct figure (reciprocal lattice vectors and Brillouin zone) even when their calculations went astray. Bookwork definition of the Brillouin zone was well answered. In hindsight it would have been helpful to omit the statement that a=2.46 angstrom from the question; there is no specific point where the student needs this number and in fact many full-marks scripts had simply used 1/a throughout. There were a number of ways used for inferring the intersection points for the Brillouin zone (rotation and scaling of earlier hexagon, trigonometry, inference from a triangular lattice) and in addition to these some students had clearly memorized the answer!
   Overall the answers were strong, but a fuller test of non-textbook results would have been valuable.
3) Quite a popular question, answered moderately well. (a) The students all had a generally correct idea of the meanings of wavefunction, operator, eigenfunction, eigenvalue, although for the latter pair several students just defined the mathematical meaning instead of giving the significance in the context of QM as instructed by the question. Two elements of the question that were less well answered were, (c) and (d)(ii).
   In (c), students were asked to predict the momentum measurement possibilities given the system is in an energy eigenstate. Only about 40% of students realised that the state is the sum of two momentum eigenstates, and even then most of these were unable to understand the follow-on question on probabilities.
   Part (d)(ii) comparing quantum and classical oscillators was not well answered – while several students noted the factor of 2 between the (quantum) total energy and kinetic energy,

relatively few were also able to relate this to the classical situation in a cogent way. Overall the question had a good range of marks achieved and was probably set at the right level of challenge.

4) One of the least popular questions, with 10 attempts. Not very well answered. The first part regarding the nature of uncertainty and the uncertainty principle was moderately well answered. However in part (c) students are asked to explain how the uncertainty principle relates to certain phenomena and to provide QUANTITATIVE examples. Most students did not seem to understand that they were being asked to invent some example numbers and find the consequence of the relevant uncertainly relation for that case – because they did not understand this (even through the question was clear) it meant that several did not attempt to derive an expression and simply wrote in generally about how uncertainty might be relevant.

5) A popular question (27 attempts) which was generally well answered. Students demonstrated that they had revised well and had the text-book material committed to memory. The last couple of parts of the question, b)(v) and (c), were the least well answered. The brief outline of the derivation of the Curie-Weiss relation was often sketchy for b)(v), and the microscopic origin of room-temperature metallic paramagnetism was often rather speculative. For a future question it would be interesting to probe these topics in more detail (for the present paper, each part was worth only 2 marks).

6) A popular question, with 25 attempts. The majority of the attempts were strong regarding the main task, i.e. the Mohr's circle construction. However there were several common errors (points where the circle construction was formed around the wrong point, or incorrect point on the circumference were identified) indicating that students might benefit from further examples in their original studies. A small number of students attempted the task of finding the tensile stress angle without the construction, which typically went badly because of the increased chance of a slip in that approach. The last parts of the question were reasonably well answered, perhaps because the question structure admitted 'common sense' responses.

7) The least popular question, perhaps because it is substantially an 'essay type' question. As there were only 7 attempts, generallisations are less meaningful, however these attempts were spread evenly over the mark spectrum with several students demonstrating that they had fully revised (at least) 3 of the required 4 breakdown techniques. The final 8 mark problem part of the question concerning air pockets was not tackled particularly well, with several students unclear as to how to approach it.

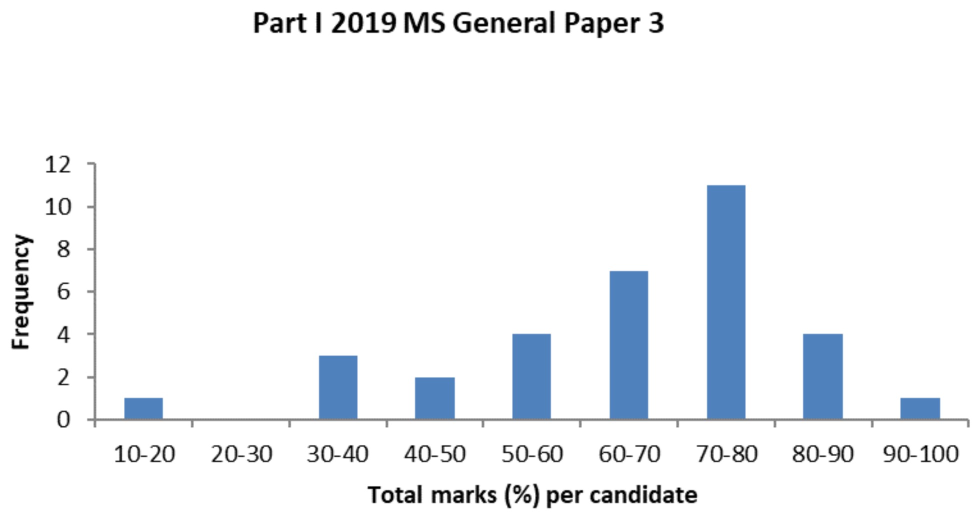
8) A question of medium popularity with 17 attempts. The major of attempts scored well, although there was a 'long tail' of students scoring lower marks. The early parts on the significance of the Fermi level and the consequence of n- and p-type dopants, where generally well handled. For those students who had revised the phenomenon of the built-in potential, the middle part of the question was also well tackled and well illustrated with sketches. A few students, having reached part (d) with good answers, then struggled to see how to relate prior results to the capacitance – nevertheless, the majority were able to provide a credible attempt at the final derivation.

General Paper 3 – Mechanical Properties

Examiner: Professor Angus Wilkinson
Candidates: 33
Mean mark: 65.79%
Maximum mark: 94%
Minimum mark: 13%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	16	13.50	20	5	Microplasticity
2	27	15.56	19	8	Mechanical Properties of Polymers
3	10	11.15	15.5	5.5	Fracture
4	24	9.08	13	4	Microplasticity
5	27	13.89	19.5	1	Mechanical Properties of Composites
6	16	13.25	18	2.5	Fatigue
7	28	14.18	20	0	Elastic Behaviour in Isotropic Solids
8	16	13.50	18	7.5	Macroplasticity & Mechanical Working Processes



General Comments

Overall this paper generated a mean mark near the targeted centre of the 2i class. The spread of marks was relatively large with many very strong scripts, including full marks awarded for some questions, unfortunately some weak scripts were also present. The distribution of attempts was not uniform suggesting either candidates had made premeditated topic selections during preparation for the examination or perceived some questions to be more difficult than others. Statistical analysis does not support there being strong correlation between the number of attempts at a question and the mean mark.

Specific Comments

1) Mathematical question developing the stress field around a screw dislocation from supplied displacement field. Lower than average number of attempts but some very strong answers including some achieving full marks. Part (d) which asked for assessment of the likely consequences of the analysis was where most marks were lost.

2) A very popular question on visco-elastic behaviour of polymers, with a high mean mark. Parts (b) and (c) were answered extremely well. Weaker scripts tend to lack precision in defining linear visco-elastic behaviour in (a), and labelling the figure required in (d).

3) A reasonably straight forward question on fracture, though appearing lengthy at 1.5 pages on the exam paper. The question was unpopular and returned a relatively low mean mark. The analysis for a double cantilever beam specimen in (b) was answered satisfactorily, but some struggled with using the result to interpret example load-displacement data.

4) A generally popular question on strengthening in metallic alloys, which returned the lowest mean mark for the paper. Part (a) requested a comparison of hardening from interstitial C, and substitutional Cr or Mo in iron. Answers lacked the detail sought for full marks in a finals level paper. Parts (b) and (c) developed analysis of strengthening from coherent precipitation but in many cases scripts did not deliver the arguments being sought.

5) A popular question on mechanical properties of composites. Part (a) sought a general description of failure under tensile loading of a unidirectional composite, and some systems exemplifying different behaviours. The examples were often not well chosen. The analysis based on rule of mixtures arguments in (b) was well done, as was that in (c).

6) Question on fatigue that had fewer than average number of attempts. In part (a) some answers failed to give clear distinction between different mechanisms of fatigue crack initiation. Part (b) was the least well answered section and concerned the plastic displacement at the crack tip and the formation of striations. The calculation of fatigue life in (c) was generally well done.

7) A popular question on elasticity of spherical pressure vessels. There were some very strong answers and full marks were awarded. Part (a) was straightforward thin wall analysis which was well done. Part (b) asked for standard analysis developing the form of stress distributions for spherical symmetry which was again generally well done. Part (c) required boundary conditions to be applied and this is where the majority of marks were lost.

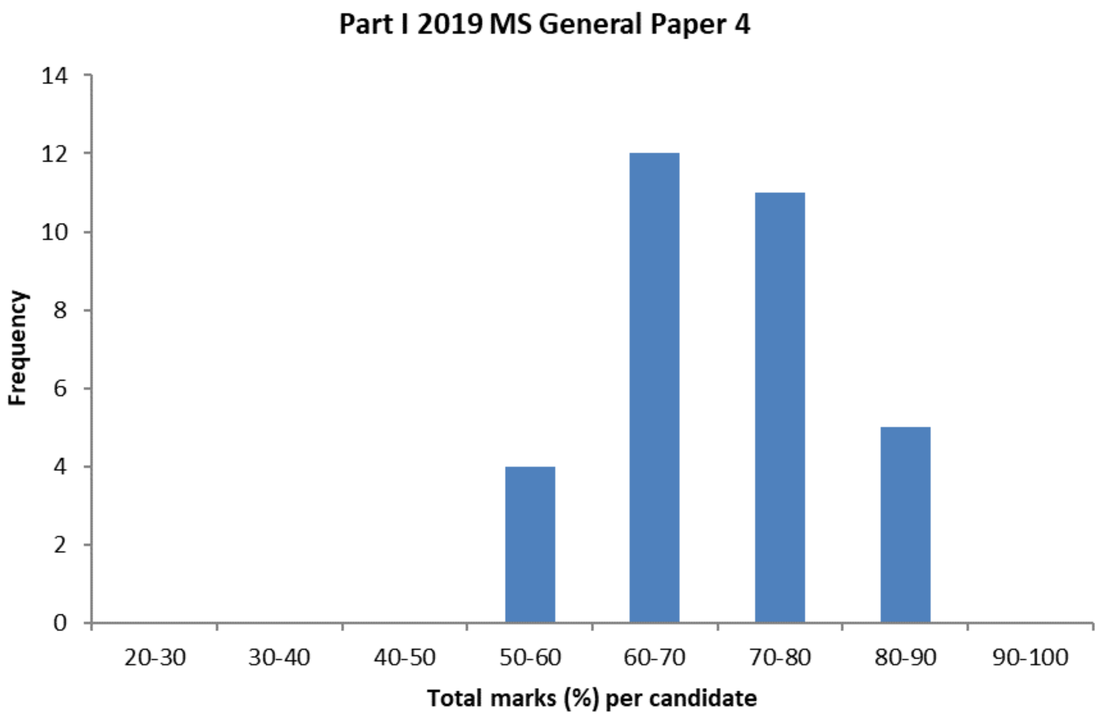
8) One of the less popular questions, which covered yield criteria and in particular Tresca and von Mises criteria. Answers to parts (a) and (b) often lacked sufficient detail in describing yield criteria and experimental testing methods needed to establish them. The calculation in part (c) was generally well done.

General Paper 4 – Engineering Applications of Materials

Examiner: **Professor Roger Reed**
Candidates: **32**
Mean mark: **70.66%**
Maximum mark: **85%**
Minimum mark: **53%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	9	14.33	17	12	Semiconductor Devices
2	22	13.64	19	4	Ceramics & Glasses
3	18	14.06	19	6.5	Ceramics & Glasses
4	26	16.13	19.5	12	Microstructural Characterisation
5	21	12.90	18.5	8	Microstructural Characterisation
6	7	12.29	15.5	9	Engineering Alloys
7	27	15.67	19.5	8	Engineering Alloys
8	30	16.30	20	10	Engineering Applications of Polymers



General Comments

On the whole, the paper distinguished satisfactorily between the most able and best prepared candidates on the one hand, and those who were less proficient on the other.

Nonetheless, the mean score for the paper was a little high and then examiners needed to scale the marks downwards, to a slight degree, implying that the paper overall was slightly too easy and/or there was a degree of question spotting of easier questions. There is evidence to suggest that this was due to Question 4 and also Questions 7 and 8 which were the most popular on this paper, possibly because they were somewhat derivative of previous examination questions – it can be argued – or else formulaic in their required recapitulation of taught material.

Specific Comments

1) Engineering Applications of Polymers. A good question which, whilst not being very popular, distinguished well between the most able and best prepared candidates on the one hand, and those who were less proficient on the other. A good blend of the descriptive and numerical.

2) Semiconductor Devices. This qualitative question on electronic materials was popular and, in retrospect, of appropriate standard.

3) Microstructural Characterisation of Materials. Question on electron diffraction, diffraction patterns and relationship to systematic absences. Good question which was discriminative.

4) Microstructural Characterisation of Materials. A popular question which built upon material the students had seen in part in tutorial sheets. This may well explain why the students scored well, on average. But there was a good spread of scores for this question.

5) Engineering Alloys. Question on nickel-based superalloys but which aimed also to test more broadly into the topics of crystallography and strengthening theory. Not popular, implying high perceived difficulty; nevertheless a reasonable spread of marks.

6) Engineering Alloys. Question on steels and in particular the role of the cementite phase in strengthening this class of material. Students were asked to think about topics on what they had been taught, but laterally. There were some very good answers, but also some poor ones.

7) Ceramics & Glasses. A very popular question answered by the vast majority of the cohort. The students scored well on average. Good blend of descriptive and numerical parts. Probably not quite challenging enough.

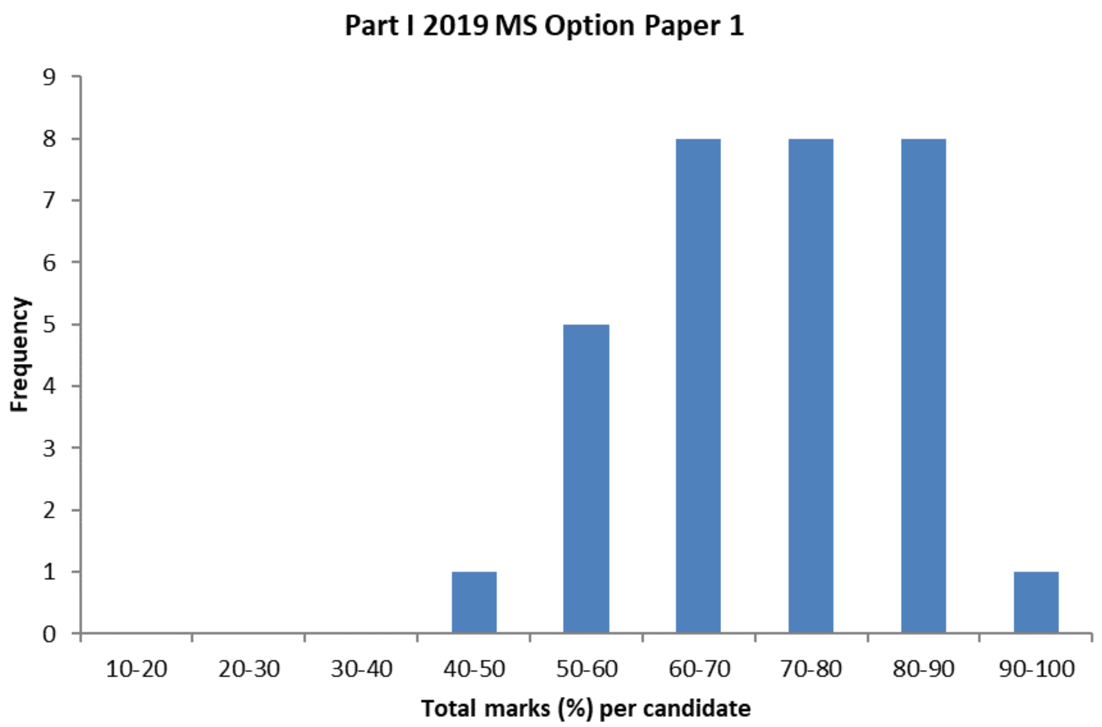
8) Ceramics & Glasses. A very popular question answered by the vast majority of the cohort. In retrospect, derivative of questions asked in previous years and with thus insufficient capacity to separate the excellent and less-good students. This contributed to an overall high average score for this question and thus the paper overall.

Materials Options Paper 1

Examiner: Professor Martin Castell
Candidates: 33
Mean mark: 69.61%
Maximum mark: 94%
Minimum mark: 24%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	14	17.18	23	3	Advanced Manufacturing
2	12	19.17	24.5	9	Advanced Manufacturing
3	4	17.50	23.5	14	Nanomaterials
4	3	10.17	16.5	1	Nanomaterials
5	14	17.29	25	8.5	Prediction of Materials Properties
6	20	19.70	23.5	14	Prediction of Materials Properties
7	11	19.32	23	15.5	Optics and Optoelectronics
8	13	19.54	24	11.5	Optics and Optoelectronics
9	20	15.53	22	7	Engineering Ceramics
10	19	15.61	23.5	5.5	Engineering Ceramics



General Comments

The average for this paper was 69.6%, which is towards the upper bound of the aspirational range for finals papers, and indicates that the paper was probably set towards the easier end in terms of level of difficulty. Excluding the one extreme minimum mark (24%), the range was from 48% to 94%, which is quite broad, and allowed the stronger students to distinguish themselves. As in previous years, the *Nanomaterials* questions were particularly unpopular and were answered by few students, namely Q3 (4 answers) and Q4 (3 answers). The *Optics and Optoelectronics* questions received high average scores. The questions were marked by the setters, Martin Castell (Q:1-4,9-10) and Simon Benjamin (Q:5-8).

Specific Comments

1) Advanced Manufacturing: This question concerned the properties and casting processed associated with aluminium alloys. The structure of the question was such that it did not increase with difficulty towards the end, but probed a variety of elements of moderate difficulty. It was in the mid-range of popularity.

2) Advanced Manufacturing: This was a question on nickel-based superalloy turbine blades. In the mid-range of popularity, but answered well by a quite a few students. The question was not graded in term of difficulty.

3) Nanomaterials: A question on the manufacture of $N@C_{60}$, C_{60} molecule structure, and the NMR spectrum of aldehyde propanol. Only answered by a handful of students. The diverse range of elements in the question meant that three separate aspects of this course were probed.

4) Nanomaterials: This was a question on graphene and carbon nanotubes. It concerned graphene processing and Raman characterisation, and separately the chiral aspects of nanotubes. It was a straightforward question, but was only answered by few students.

5) Prediction of Materials Properties: The distribution of marks showed a typical unimodal distribution. This question involves phonon dispersion relations for a hypothetical 1D solid. Generally the students show a good understanding of the topic, and benefited from the structure of the question which lead the student through it. An external examiner had commented "Overall this appears to be a very challenging question" (prior to the exams) and so it was gratifying to see that the students tackled it well. For part (f) where students are required to obtain a specific equation, there were a couple of attempts that 'worked the problem from both ends' and yet failed to join in the middle, however in the main it was tackled well.

6) Prediction of Materials Properties: The distribution of marks was unimodal skewing to the high end. The question concerned the properties of phonon-mediated superconductors and provides a mix of textual answers (explanations, definitions) and derivations. The question was well answered, demonstrating that the students have a solid grip of the topic. In hindsight it may have been valuable to set a slightly more testing final part to the question, and to assign more marks to it correspondingly.

7) Optics and Optoelectronics: The mark distribution was fairly flat. This question concerns solar cells and the majority of the marks (15) were allocated to short essays on three specific types of cell. This section was generally well tackled with most students scoring highly on at least two of the three types (but varying as to which was the weaker one). The middle part of the question concerned extracting simple quantities from a provided I-V curve, and this was very well done indicating that student had practiced this component thoroughly. As with Q6, the last part (intended to stretch students a bit) was rather brief and it may be that it would have been better to assign more weight to a more challenging section.

8) Optics and Optoelectronics: There were several strong answers with only a couple of students scoring below 70%. The question concerned optical amplification and lasing. The question

was long (as noted by an external examiner) but highly granular with most parts worth two or three marks - it may be that this somewhat reduced the challenge of the question and possibly a grouping of marks into larger sections would have provided the markers with a more nuanced capability to score the quality of the answers. Nevertheless, the question was well answered and indicated that the students understood the course material.

9) Engineering Ceramics: This was a popular question. It was on particle size distributions and how they affect sintering behaviour, followed by a calculation related to hot isostatic pressing. Most student were able to deal with these parts. The final part on thermal shock was more bimodal in that some student were able to answer it well, but some only poorly.

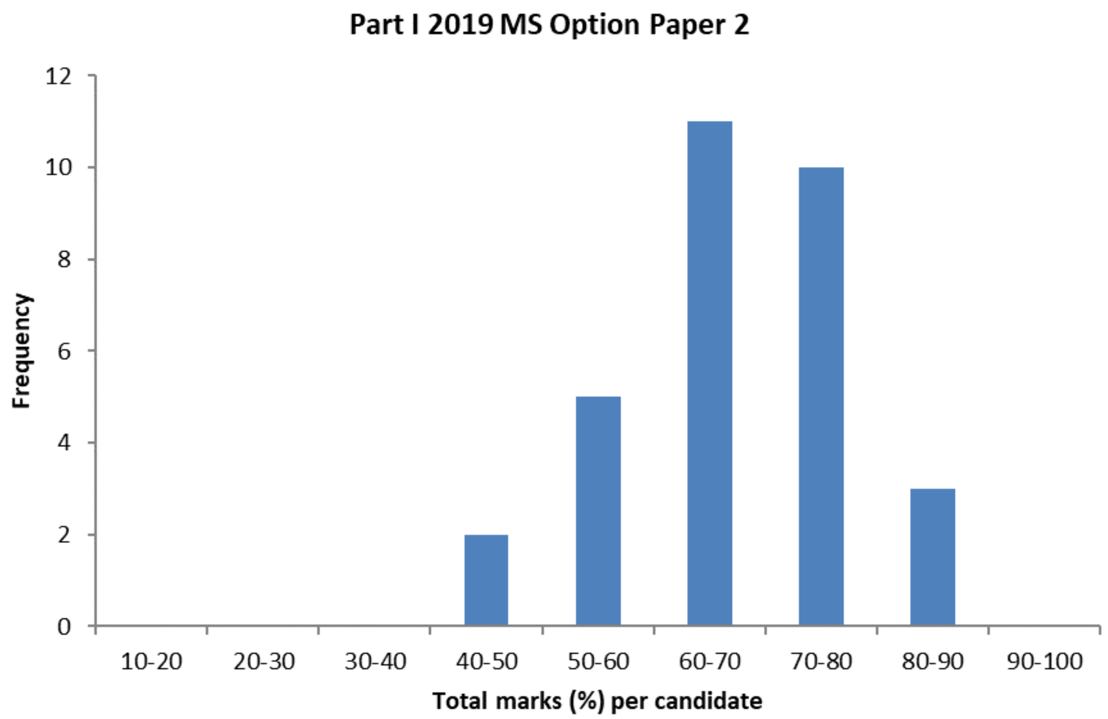
10) Engineering Ceramics: A popular question on the Weibull distribution and applications and constraints of 3-point bend tests. Most students answered the majority of the question well, but the final part [c(ii)] concerning the implication of moving the loading point was only correctly answered by a few students.

Materials Options Paper 2

Examiner: **Professor Keyna O'Reilly**
Candidates: **32**
Mean mark: **66.84%**
Maximum mark: **87%**
Minimum mark: **43%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	28	16.75	22	9.5	Advanced Polymers
2	9	18.83	22	15.5	Advanced Polymers
3	8	16.88	21	14.5	Materials for energy prod^{n}, distrib^{n} & storage
4	5	17.50	20.5	12.5	Materials for energy prod^{n}, distrib^{n} & storage
5	9	14.83	21	10.5	Advanced Engineering Alloys and Composites
6	6	14.25	16	12.5	Advanced Engineering Alloys and Composites
7	25	18.58	23.5	11	Biomaterials and natural materials
8	14	15.18	22	9	Biomaterials and natural materials
9	13	17.08	22.5	10	Devices
10	10	14.90	22.5	6.5	Devices



General Comments

A satisfactory paper with a good spread of marks, range of individual question scores and overall paper average. The two most popular questions were from the Advanced Polymers and Biomaterials courses, and the two least popular were from Materials for Energy and Advanced Engineering Alloys courses.

Specific Comments

1. Phase separation in polymers
   The most popular question on the paper receiving many more attempts than the average but resulting in marks that were near the mean for the paper.
   In part (a) descriptions of miscible and immiscible were generally clear but candidates lost marks for rather vague or incorrect descriptions of partially miscible. Part (b) was generally well answered with good diagrams. Weaker aspects were in identifying what nucleates in nucleation and growth and what the origin of the energy barrier is. The finer lengthscale coming from spinodal decomposition was not always stated. In part (c) many candidates did not give a physical reason for the increase in intensity, and often did not comment on the reducing wavevector with time. A few candidates mistook time data for temperature leading to unphysical results.

2. Advanced polymers
   A wide-ranging question which was not very popular but was generally well done. (a) The rotational isomeric state model for motion of a single polymer chain. Most candidates could identify the two angles that modify the basic random walk principle, but the definition of the angels was often wrong or unclear, and few candidates explained/introduced the relation $r^2=nl^2$. (b) Most candidates could define the radius of gyration and appeared to understand it's significance in relation to the thin film. More candidates considered dewetting than anisotropy for the layer to be accommodated in less than twice the radius of gyration. (c) i) Generally good at what contrast matching is, but descriptions of how it is used were often weak. ii) Sometimes confusion as to which structure factor. iii) Mostly reasonable answers, perhaps weakest on the information that can be derived from the structure factor profile. (d) i) One or more steps in the LCA were often missing, and some candidates did not make the loop associated with recycling. ii) Generally well answered.

3. Energy production.
   Most students had surface knowledge of the key points, but the majority of answers lacked the depth and detail that would be expected at third year level, and which was available from lectures and required reading. (a) Some misunderstanding of the meaning of strategic resources and some did not clearly discuss whether clean energy systems were strategic or not. (b) This required a discussion on the relation between tower/blade size to power and the link between power and generator mass, which affects structural loading. Some noted the opportunity of improved generator materials, but nobody explained correctly why this would reduce mass significantly. (c) i) Mechanisms of moderation and benefits for fuel efficiency and enrichment not well explained. ii) Some confusion over the details of breeding and burning of Pu and actinides. iii) Mostly correct. (d) Answers lacked metallurgical detail on what elements do.

4. Energy production and storage
   An unpopular question which covered a wide range of topics. (a) Covered fracking and Li ion batteries. (b) Covered coal combustion and coal gasification. These sections, despite being bookwork, were generally rather poorly answered, with insufficient description and often lacking key details. (c) Was a more stretching question introducing heliohydroelectric power generation and involved calculating the critical time taken for the dam to come into operation and the power that it would generate. this more challenging part of the question was generally very well answered.

5. Steels
(a) The question covered the manufacture and use of a steel whose composition was given. The roles of specific elements and a potential application were generally well covered. (b) Required sketches and descriptions of the steel microstructures after various heat treatments. Here there was a lack of schematic microstructures and insufficient attention to the scale of the microstructure, despite it specifically being required in the question. Several answers had ferrite forming instead of austenite. There was a tendency in some answers to include every possible phase transformation that could occur in steels. (c) Most correctly identified spinodal decomposition as being the phase transformation in a second steel. (d) Generally good answers.

6. Martensitic transformations
An unpopular question which was generally not well answered. (a) Questioned the accuracy of a statement about martensite. Despite the question specifically asking for alloy systems where the statement would not be fully accurate, not a single candidate referred to a martensitic reaction in an alloy system other than steels, and hence key arguments were lacking. (b) Was specific to steels, as given in the question, and was generally well covered. (c) Asked about the role of carbon in martensitic transformations in steels. this was generally well covered though there was a lack of schematic microstructures.

7. Bioactivity and hip replacements
A very popular question that was well answered. Most of the question was straightforward, general bookwork, with the addition of a section involving real-life examples which required the candidates to apply their knowledge. (a) i) bioreactivity spectrum and how it can be used to describe interactions between devices and tissue was generally very well answered. ii) Materials were generally correctly categorised. iii) Methods for modifying bioactivity were generally correctly decribed. iv) This section required candidate to identify biomaterials given their reported reactions to being implanted, and is where marks were most frequently lost. (b) Involved describing methods for hip replacement, and was generally well done.

8. Drug delivery devices and materials for blood vessel replacement
(a) This section covered mechanisms for drug delivery combined with specific examples and was generally well answered. Some descriptions of mechanisms lacked sufficient details and some incorrect methods for targeting drug delivery devices at a particular site in the body were given. (b) This section covered materials for blood vessel replacement. Most candidates could name the two most commonly used polymers but some answers lacked details of the microstructures and properties which enabled their use. Part (ii) required calculation of a misfit strain and the question incorrectly identified the radial stress as the dominant component. despite this, most candidates correctly used the hoop stress and those few who did not were awarded marks for correct working given the incorrect assumption.

9. Type I superconductors
(a) This section covered the critical parameters required for a type I superconductor to be thermodynamically stable and the energetic arguments for how they are related, and was generally well done by the candidates. One candidate misinterpreted what was expected, but on re-reading the question the examiners could understand the misconception and hence appropriate marks were still awarded. (b) The main arguments for the influence of coherence length and penetration depth on surface energy were also made quite convincingly by the majority of candidates. (c) This section, on single photon detectors, was the least well answered. Many candidates only had a very sketchy understanding of how the device works, with some getting very confused between breaking apart Cooper pairs and creating e/h pairs in semiconductor devices. Most had no idea about materials considerations – many thought that the nanowires are drawn rather than made by lithographic patterning of a thin film, and based all of their materials selection on the ease of drawing the materials as wires.

10. Growth of single crystals

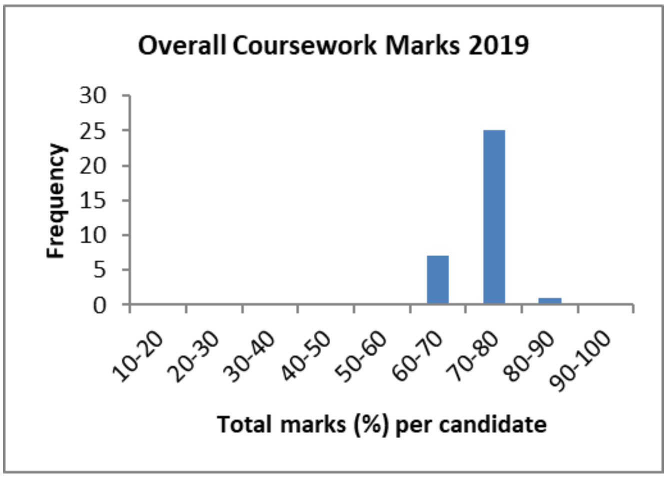
This question was on the use of silicon for microprocessor chips, its manufacture as single crystals by the Czochralski process and how crystal originated particles can occur and how they can be minimised. It was predominantly bookwork, except for part (a) which required the students to think about why silicon is the semiconductor of choice for high temperature electronics. there were no sections of the question which were particularly well or badly answered. Most candidates showed a good understanding of the material covered in lecture with quite a few good marks. However, some answers suggested that the candidates attempted the question out of desperation, as there was nothing else on the paper that they could do.

COURSEWORK

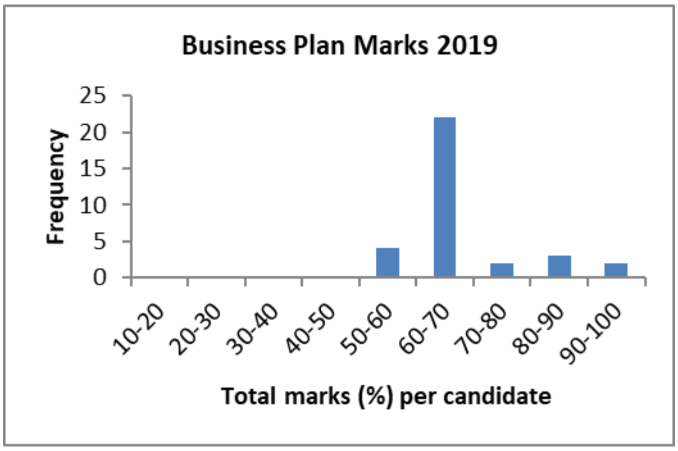
A maximum of 200 marks are available for Part I coursework which comprises:

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

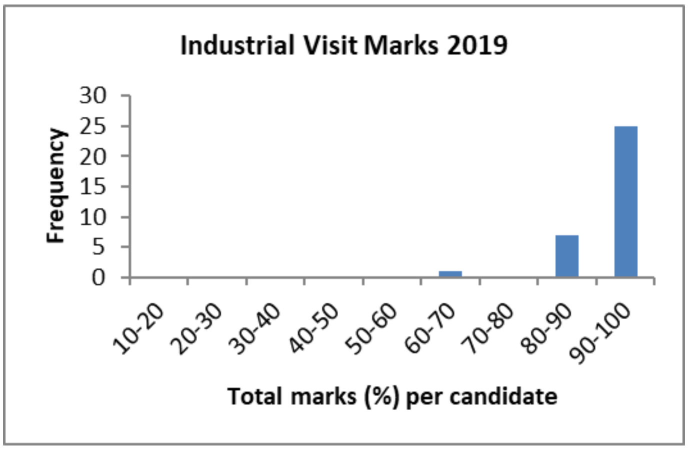
Overall coursework marks were good, and in the range expected for what is generally continuously assessed work.



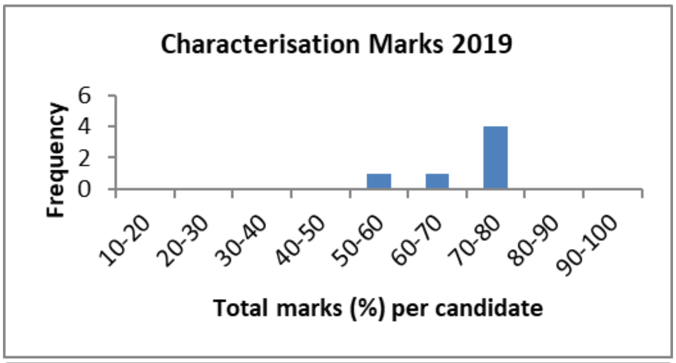
The **Business Plan** marks (average 60.37%) are in a narrow range except for the outlier high mark that is for optional examined course taken by one student. This mark is also high compared to the non-materials students that took this course, and reflect individual excellent performance.

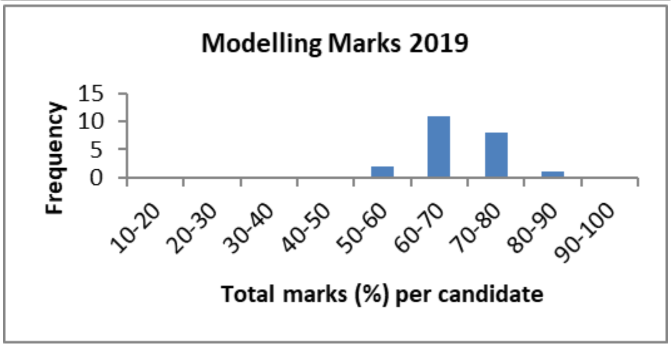


The **Industrial Visits** mark (average 96.5%) are high, as full marks can be obtained by producing a good report; the small number of reports that are only satisfactory or late are strongly penalised.

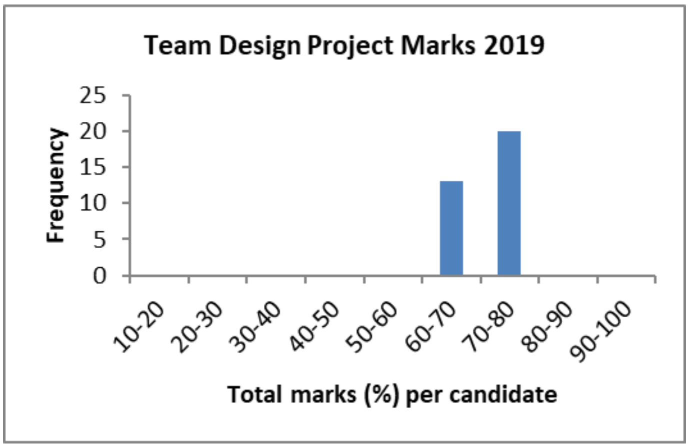


The **Advanced Characterisation** module (average 73.71%) and **Introduction to Modelling in Materials** (average 67.56%) both show a reasonable range from lower second to good first class; the work done has been reviewed independently by the examiners.

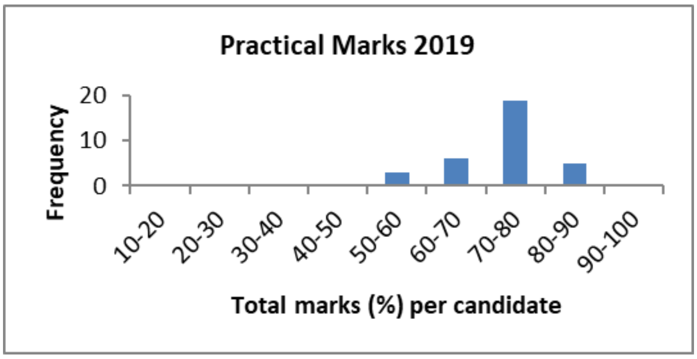




The **Team Design Project** marks (average 70.1%) show a quite narrow range, close to the upper second/first class level, which is reasonable given the sustained effort in a group task.



The marks for **Practical Classes** (average 72.7%) 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. The practical marks are quite narrowly distributed, and reflect the sustained effort and engagement by students across the practical classes and in their reporting.



Practical No	Average Mark	Highest Mark	Lowest Mark
2P1	7.45	9.00	4.50
2P2	6.58	8.04	5.00
2P3	5.96	8.50	0.50
2P4	7.87	10.00	6.00
2P5	7.07	9.00	3.50
2P6	6.40	8.50	4.50
2P7	8.00	9.00	6.00
2P8	8.18	10.00	5.00
2P9	6.70	8.00	6.00
2P10	8.18	9.60	5.00
2P11	6.75	9.00	5.00
2P12	7.41	9.31	6.03

Report from the Practical Classes Organiser
Materials Science 2^{nd} year Practical Labs in 2017/18

I have reviewed the marks from the 2^{nd} year Practicals from 2017-18. There is quite a wide range of overall average marks ranging from 58 to 87%, which is in line with past years records. The range of marks for an individual practical vary from practical to practical. They were all within 10% of each other for practicals 2P1, 2P2, 2P4, 2P7, 2P9, 2P10, 2P11 and 2P12. Practical 2P3, 2P5, 2P6 and 2P8 had a 15%, 13%, 13% and 13% spread respectively.

Two candidates each presented a medical certificate to justify missing individual practicals and were excused from the practical by the Proctors. The missed practicals were those for which the cohort averages were at the upper end of the range of averages across all eleven examined practicals, thus disadvantaging the two candidates who missed practicals for legitimate reasons. Therefore it is recommended that an alternative approach is used, following the precedent of previous years. It is suggested that (i) the candidate's **rank** within the cohort for the practical course as a whole be established by calculating for each member of the cohort an average mark based only on the practicals that the candidates in question were able to complete, and (ii) this candidate's raw average be 'scaled' in order to maintain the aforesaid rank within the distribution of **actual** overall FHS Practical Course marks for the whole cohort.

Gender: I have assessed the marks for gender imbalance by looking to see who has received the highest and lowest marks for each practical. Male students consistently received the lowest marks and female students consistently received the highest marks, though as the same students consistently appear as either highest or lowest this suggest an accurate reflection of their performances.

Penalties: I have looked at the suggested penalties and am recommending that these are accepted in their entirety.

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

Hilary Term 2018 – 2nd years

-2P1 Diffusion: SD away on Tuesday and Wednesday of 4th week. Students wanted to talk to him. He had told the students to read the briefing notes in advance of the SD's briefing and he was present in the lab all of Monday afternoon.

-2P6 Extrusion: 1 candidate was unwell during write-up of the practical and submitted a medical certificate as supporting documentation. Correctly, the SD marked this without this knowledge.

Other items of note

Trinity Term 2018 – 2nd years

-2P4 AFM: AFM broken. This was identified a few days before the practical was due to start and the SD rewrote the practical to use the XRD. This was done in time that all students did the same practical and so all were treated equally.

Practical Class Organiser – Sergio Lozano-Perez
June 2019

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

Part I

A. STATISTICS

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

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

Class	Number			Percentage (%)		
	2018/19	2017/18	2016/17	2018/19	2017/18	2016/17
I	11	9	8	34.4	31.0	25.0
II.I	17	16	21	53.1	55.2	65.63
II.II	2	3	1	6	10.4	3.1
III	1	1	1	3	3.4	3.1
Pass	0	0	0	0	0	0
Fail	1	0	0	3	0	0
Total	32	29	31	-	-	-

(2) **The use of vivas**
The Part II examination in Materials Science consists only of a research project, for which a thesis not exceeding 12,000 words, or 100 pages, is produced. The mark for the Part II is for the thesis alone. All candidates 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 the vivas was led by the internal Examiners or Assessors who had read the thesis fully but the other examiners, including an external examiner, also had the opportunity to ask questions.

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

B. NEW EXAMINING METHODS AND PROCEDURES

None

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

It is recommended that the Part II theses are submitted in both printed and digital copy; the latter will allow for standard plagiarism checking to be carried out.

D. EXAMINATION CONVENTIONS

The current year’s Conventions (2019, attached) were put on the Departmental website and sent electronically to all candidates on 1 March 2019. 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 32 candidates whose results were ratified by the examiners 31 were awarded Honours. The examination required the candidates to submit a thesis (maximum 12,000 words) on a research project carried out by candidates during the year, usually in the Department of Materials. Candidates were given a 25 minute viva, during which they were asked detailed questions on their thesis and research work.

The theses were mostly of a high quality, and the candidates were able to explain their work well in the vivas. Of those who passed, the marks for the Part II examination ranged from 40% to 82% with an overall mean mark towards the top of the 2(i) range. The external Examiners played an important role in the discussions that lead 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.

This year, one student submitted a Part II thesis with a small portion which had been plagiarised. After a long discussion between the examiners and the externals – after consultation of the written procedures and recommendations – it was decided to deal with this without the help of the proctors. The candidate concerned was penalised by 10%.

Due to the larger number of students to be examined at Part II this year, two assessors were appointed in addition to the six examiners.

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

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

There were no applications for consideration for specific learning difficulties made for the Part II component of the exam process this year.

	Overall mark		Part 2 Project		Part I Mark	
mark (%)	Male	Female	Male	Female	Male	Female
30-40	1*	-	-	-	-	-
40–50	-	1	-	1	-	1
50–60	2	-	2	-	4	1
60–70	13	5	11	7	11	4
70–80	7	3	8	-	8	2
80–90	-	-	1	1	-	1
Totals	23	9	22	9	23	9

* Part II report not submitted

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 (2018) and Part II for these candidates are given above.

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

(1) Mitigating Circumstance: Notices to Examiners.

One application for consideration of Mitigating Circumstances: Notices to Examiners were submitted. [redacted]

[redacted]

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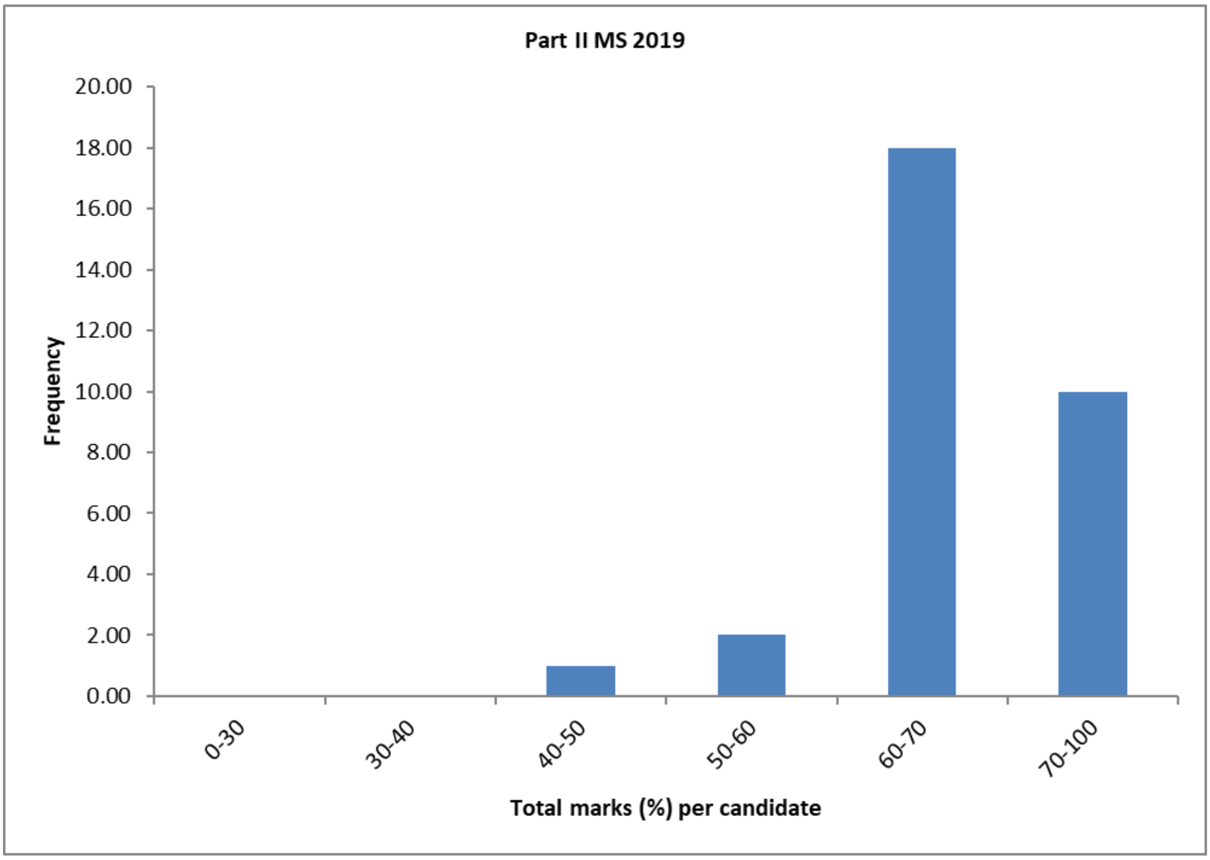
F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

Prof. S.C. Benjamin	Prof. M.R. Castell
Prof. K.A.Q. O'Reilly	Prof. R.C. Reed (Chair)
Prof. A.J. Wilkinson	Prof. J.R. Yates
Prof. A.J. Davenport (external)	Prof. P.D. Haynes (external)

Report on Part II Projects

Candidates: **32**
Mean mark: **67%**
Maximum mark: **82%**
Minimum mark: **40%**

Detailed comments on the paper are as follows:



General Comments

The vast majority of the Part II theses were of a very high standard, as confirmed particularly by the views of the external examiners this year; some were truly outstanding.

The assessment of the theses followed closely the marking guidelines published in the Part II handbook. However, some theses were deficient in factors that are clearly identified there and all students are recommended to pay close attention to this. The sections requiring the students to reflect on the engineering impact of their work was not always dealt with well, and this commented on again this year by the externals. It was evident that some students had not allowed sufficient time for writing, reviewing and proof-reading, with parts of their thesis being less well written and presented than others.

Candidates should remember that they are examined on the submitted paper thesis. In several cases figures, particularly micrographs, where poorly reproduced in the printed copy. It might have been that these rendered fine on a computer screen. Students are advised to print test copies of their figures in sufficient time so as to be able to fix any problems.

In a small number of cases it was clear that while a student had done excellent laboratory work and had had a significant creative input to their project, the examiners could not fully reward this due to major deficiencies in the thesis. This was disappointing. The criteria for a good thesis are clearly set out in the PtII handbook; the examiners adhere to these.

Examination Conventions 2018/19
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 2018-19. 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 Course Handbook are the editions published in the year in which the candidate embarked on the FHS programme. The Examination Regulations may be found at: http://www.admin.ox.ac.uk/examregs/.

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, in particular, 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.

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.

Materials Option papers comprise one section for each twelve-hour Options lecture course, each section containing two questions: candidates are required to answer one question from each of any three sections and a fourth question drawn from any one of the same three sections. The 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.

[1] for the 2018-19 examinations the Nominating Committee comprised Prof Grant, Prof Marrow & Dr Taylor.

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 examiners 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 Chairman, or another examiner as appropriate, to adjudicate. An integer total mark for each paper is awarded, where necessary rounding up to achieve this.

Options papers are marked by course lecturers acting as assessors and an examiner acting as a checker.

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

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*

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

(3) *Engineering and Society*

The business plan for "Entrepreneurship and new ventures" 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 at the 'Building a Business' tutorials, the slides from which are published on WebLearn.

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 WebLearn

(5) *Advanced Characterisation of Materials and Introduction to Modelling in Materials Modules*

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

Part II Coursework

The Part II project is assessed by means of a thesis which is submitted to the Examiners, who will also take into account a written report from the candidate's supervisor. The 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 project management chapter, together with Part A of the supervisor's report, and each of them independently allocates a provisional mark based on the guidelines***** published in the course handbook. In addition, normally the thesis will be 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. An examiners' discussion is held after the viva, involving all Part II examiners, excepting any who have supervised the candidate's Part II project or are their college tutor. During this discussion 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 students is small, it is not unusual for mean marks to vary from paper to paper, or year to year. It is not therefore normal practice to adjust marks to fit any particular distribution. However, where marks for papers are unusually high or low, the examiners may, having reviewed the difficulty of the paper set or other circumstances, decide with the agreement of the external examiners to adjust all marks for those papers. 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 the cover slip is not completed 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 cover slip. If the cover slip is not completed 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; Engineering & Society Coursework (or substitution); Team Design Project; Advanced Characterisation of Materials or Introduction to Modelling in Materials. For the Practical Classes and Industrial Visits, the element of coursework comprises a set of reports: reports on four Industrial Visits and reports on twelve Practical Classes as specified in the Course Handbook. In these cases, a candidate must submit a report for each visit/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 Engineering & Society Coursework; 2. A set of twelve 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 four Industrial Visit Reports as specified in the course handbook; 5. A report on the work carried out in either the Advanced Characterisation of Materials module or the Introduction to Modelling in Materials module; and 6. A

Part II Thesis). Rules governing late submission of these six 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 2018/19 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 14.9. 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 14.9 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 14.10. In the case of submission on the prescribed day for the submission but after the prescribed time on that day for the submission and without prior permission from the Proctors: 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, taking into account any circumstances communicated to the examiners by the Proctors should they approve a request by the candidate, submitted to the Proctors via the Senior Tutor of their college within five working days of notification of non-submission, that the examiners take into account the circumstances of the late submission.

(c) Under para 14.11. In the case of submission 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%.

(d) Under Para 14.12. 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.

Where an element of coursework is not submitted or is proffered more than 14 days after notification of non-submission 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 Examiners, permit the candidate to remain in the examination. In this case *for the element of coursework in question* (i) the Examiners will award a mark of zero and (ii) dispensation will be granted from the Regulation that requires a minimum mark of 40% if the candidate is not to fail the examination as a whole.

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 2017/18 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 2017/18 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 Chairman 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 2017/18 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 (http://www.admin.ox.ac.uk/media/global/wwwadminoxacuk/localsites/educationcommittee/documents/policyguidance/Plagiarism_procedures_guidance.pdf):

(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. 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).

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 five 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 year following the examiners' original decision. The examination will be identical to that taken by the other Part I candidates in said academic year. 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.]

Where a candidate or candidates have made a submission, under Part 13 of the Regulations for Conduct of University Examinations, that unforeseen factors may have had an impact on their performance in an examination, the internal examiners 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.

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, the internal examiners will take into consideration the severity and relevance of the circumstances, and the strength of the evidence. 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, the 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 internal examiners will take into consideration 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 *Policy and Guidance for examiners, Annex C* and information for students is provided at www.ox.ac.uk/students/academic/exams/guidance*.* 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.

7. DETAILS OF EXAMINERS AND RULES ON COMMUNICATING WITH EXAMINERS

The Materials Science Examiners in Trinity 2019 are: Prof. Simon Benjamin, Prof. Martin Castell, Prof. Keyna O'Reilly, Prof. Roger Reed (Chair), Prof. Angus Wilkinson and Prof. Jonathan Yates. The external examiners are Prof. Alison Davenport, University of Birmingham, and Prof. Peter Haynes, Imperial College, London.

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 2019 (For Part I and Part II students who embarked on the FHS respectively in 2017/18 and 2016/17)

	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
	Characterisation or Modelling module	50
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 be identical to that taken by the other B.A. candidates in said academic year. 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 2019

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
	Characterisation or Modelling module	50
	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
	Characterisation or Modelling module	50
	Literature-based research module	50
Overall Total		**850**

Reports from the External Examiners for Materials

External examiner name:	Professor Alison Davenport
External examiner home institution:	University of Birmingham
Course examined:	Materials Science
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?	✓		
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 6 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.*** *Further comments may also be given in Part B, if desired, if you answer "Yes" or "N/A / Other".*				

Part B
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 academic standards achieved by the majority of students are very high and compare very favourably with those in Materials Science and Engineering at other 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 performance was generally of a high standard relative to those of other universities in the examination papers, coursework and particularly in the project reports and vivas.

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.

The assessment process was conducted rigorously and in a fair manner consistent with the University's regulations and guidance to ensure equitable treatment of students.

Questions on exam papers were generally of a very high standard and well structured, typically with part of each question testing core material and the remainder challenging the students to apply their knowledge in new ways. On some questions, it was clearly stated which parts tested core knowledge, and which parts were more stretching; this should be regarded as best practice and encouraged across the board. However, in a few cases, questions appeared to focus solely on material that appeared to have been delivered in lectures with little or no additional challenge. I pointed out some cases of this type, but was disappointed to see that the questions remained unchanged in the final examination. In a small number of cases, this led to a high fraction of the cohort answering questions of this type with higher average marks. The time for reviewing exam papers was tight this year, and I understand that the time for revising papers was also somewhat constrained. I am concerned that this may have led to less time to address cases where significant modification to questions was recommended by the Examiners.

Where unusually high marks were obtained in particular papers, scaling was applied very carefully and rigorously to ensure fairness, bringing these papers into line with others.

Project marking was very thorough and fair, and considerable effort was made to put students at their ease in the vivas so that they had the best possible chance to perform well.

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?

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.*

There was some discussion about the fact that the examiners for each paper are typically not involved in delivering the material on which the questions are based. This means that those delivering the lectures may not see in great detail how well the students have understood the material. It was noted that further work would be carried out to “close the loop” to ensure that this concern is addressed, which I would strongly encourage.

It was with some disappointment that I raise the issue of the structure and style of the Part II project reports for the third year in succession. The science and engineering research is of excellent quality, with many students working at the level of first year PhD students, but the way in which the projects are written is very variable, and are generally not in the style that is conventional for the communication of science in, for example, journal papers.

I recommend that the serious thought is given to developing a consensus on style of the reports: are they expected to be a narrative history of the project and how it was conducted, or a piece of science writing that focuses on providing robust and convincing evidence for novel findings that are firmly set in the context of highly relevant literature? I would have a preference for the latter, as a few of the more disappointing reports focused on measurements made with relatively little critical thinking on the robustness of evidence, with relatively little thought as to the novelty and validity of the findings. In other cases, reports included descriptions of basic information at text-book level rather than focusing on the current context in up-to-date literature.

The document “What are the examiners looking for in a good Part II Thesis” is at one level helpful in encouraging students who face experimental difficulties. However, this may give the impression that a narrative approach is expected which may in turn have the effect of de-emphasising scientific rigour.

I strongly encourage the Department to take a fresh look at what should be expected from project reports and come up with very clear style guidance that is reinforced by relevant training from an early stage in the degree programme. It may also be helpful if the students could be given more detailed information about key aspects that will be taken into account in the assessment of project reports. In feedback to my previous reports, I noted plans to introduce measures to improve science communication in earlier years: I hope to see the benefit of this next year.

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.

Signed:	[signature]
Date:	29/7/19

UNIVERSITY OF OXFORD

EXTERNAL EXAMINER REPORT FORM 2019

External examiner name:	Peter Haynes	
External examiner home institution:	Imperial College London	
Course(s) examined:	Materials Science Parts I and 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?	✓		
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 6 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.*** *Further comments may also be given in Part B, if desired, if you answer "Yes" or "N/A / Other".*

Part B

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 academic standards for coursework, written examinations and research projects are all high. In particular, the requirement for students to sit all written examinations at the end of the third year requires mastery of the entire course and the devotion of the whole of the fourth year to the research project enables a reliable assessment of achievement to be made. The number of students in each class is appropriate when compared with other institutions.

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).*

There were several examples of outstanding Part II project dissertations among those that I read and most students performed well in their *viva voce* examinations. In some cases it became clear during questioning that they had started the process of analysing their results and writing up their dissertations far too late, and that their reports did not fully represent their achievements in the laboratory. For that reason I recommend that the Department issue stronger guidance about the time required for writing up or set a prior deadline for the completion of experimental work. However, the very best reports were at the level of those expected from first-year doctoral students.

Student performance in the Part I General Papers is also generally strong and reflects a comprehensive understanding of the course content that compares very well with other institutions. The proportion of marks assigned to unseen problem-solving varies between topics and questions, and it is possible that this may be facilitating a degree of question-spotting. However, this is difficult to address when all past papers are readily available and when examining some advanced topics. Overall student performance and achievement compare favourably with the standards set out in the QAA Subject Benchmark Statement for Materials and the requirements for accreditation by the UK Engineering Council.

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.

The examiners are to be commended for their thorough job of preparing the examination papers, which were remarkably clear, free of errors and well-presented. It is easy to underestimate how much hard work and attention to detail this requires. The schedule for addressing comments made by the external examiners appears to be extremely compressed. While the examiners certainly responded to comments about errors and clarity of expression, it is impossible to consider comments about the relative difficulty of questions within or across papers. I recommend that the Department reviews the timeline and considers involving external examiners at a slightly earlier stage.

At present lecturers are involved in the setting but not the marking of questions. This misses an opportunity for feedback for lecturers to see how well the students have understood the material they have been taught. I recommend that the Department discusses whether the lecturer should replace the checker as one of the markers of examination questions.

The Part II project accounts for one third of the total marks, and is currently assessed on the basis of two independent marks of the report that are moderated through the *viva voce* examination. It is evident that there is some variation between markers and this is the largest potential source of uncertainty in the final marks. While the current process successfully moderates the two marks for each report, moderation between different pairs of markers across all reports is more challenging. Currently markers have general descriptors for 10% bands for the total report mark. I recommend that the Department considers increasing the detail of this scheme to include separate descriptors for different aspects of the report such as literature review, analysis of results, presentation etc. In my view this would benefit both markers and students.

Mitigating circumstances were handled anonymously and in accordance with the University's regulations and I was satisfied that the decisions taken were both fair and compassionate. I would commend the Chair of the examiners for his careful handling of a case of poor academic practice.

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?

One case of poor academic practice (plagiarism) was identified in a Part II research project report. The University regulations appear to suggest that students are only required to complete the online plagiarism following a first offence, which was too late in this case. The Department has already introduced electronic submission of coursework and I recommend that all coursework be submitted to a plagiarism filter in future. I also recommend that the University requires all students to complete the plagiarism training at an early stage.

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.*

In the model answers provided for written examinations, some examiners had followed the instruction to indicate which sections were bookwork and which went beyond. This is extremely helpful for an outsider trying to judge whether questions are of a similar standard and how they will differentiate between those who can recall facts from notes and those who have gained understanding and can apply that to unseen problem-solving. I urge all examiners to follow this practice next year.

In the Part I Option Papers (at least OP1) I noted what seemed to me to be a helpful practice of including a one sentence summary of what the question was about at the top. Perhaps this should be obvious to the candidates upon inspection. However, for the sake of consistency this should be done for all questions or none in future.

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.

Overall the Department of Materials is to be congratulated on its high standards and the impressive attributes of its students. In particular I am grateful to Ms Philippa Moss and Professor Roger Reed for their efficient administration and effective oversight of the entire process that meant I was able to use my time as productively as possible.

Signed:	Peres Haynes
Date:	8 July 2019

Please ensure you have completed parts A & B, and email your completed form to: external-examiners@admin.ox.ac.uk and copy it to the applicable divisional contact set out in the guidelines.

Department of Materials Academic Committee

RESPONSE TO EXAMINERS' REPORTS 2019

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 FHS Chairperson's report, the Prelims Chairperson's report and internal reports on all of the individual Materials papers, FHS and prelims, 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 2019 Examinations.

2. Points for inclusion in Responses to the External Examiners

MS Parts I & II: Professor A. Davenport

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

We address below Prof Davenport's comments and her concern that her previous comments on the structure of the Part II thesis have, to use the proforma rubric 'not been properly considered or acted on'. Our teaching committee did carefully consider her previous comments, addressing them explicitly in our written responses of 2017 and 2018, but it is correct that we have not yet fully implemented all the associated actions and we apologise for this. Some actions have been implemented; in particular we have (i) improved the guidance we provide to students on their coverage of the 'engineering context', and (ii) taken various steps to embed proper use of laboratory notebooks - in respect of the Part II thesis this latter change will be most clearly evidenced when our current first-year students, who are the first cohort to follow our substantially revised 'Prelims' programme, reach their Part II year in 2022/23. As described below, the remaining actions are now in hand for the 2019/20 Part II cohort.

● We have modified the timeline for drafting the written papers to allow an additional week for the review stage involving the external examiners and noted the importance of the Chair of Examiners informing the external examiners in writing of the actions taken in response to their feedback on the draft papers.

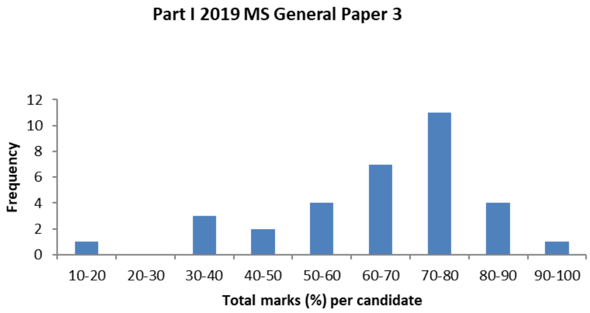
● The attention of the Chair of Examiners for 2019/20 has been drawn to the need for all examiners and question setters to (i) adhere to the Department's requirement that specimen answers for exam questions should indicate which parts are bookwork and which go beyond this and (ii) note the expectation that an exam question should include some content which enables differentiation within the first-class band of marks.

● As may have been mentioned by our internal examiners during the July 2019 Exam Board, the Faculty of Materials had already discussed and agreed in principle to move to an exam marking process for all FHS written papers where the questions are marked by the lecturer and an examiner, rather than our current practice of marking by two independent examiners for the majority of FHS written papers. At present the lecturer + examiner arrangement occurs only for the two, specialist, Materials Options Papers. To apply this arrangement to all written papers efficiently and effectively we need to move to on-line distribution and marking of scripts that have been digitally scanned and uploaded. This on-line process will be piloted for one or both Materials Options Papers in the Trinity Term 2020 Part I written examinations. Subject to a positive outcome for the pilot we anticipate that for all six **2021** FHS written papers the lecturer will be one of the two markers for the questions on their courses.

Although the direct benefit of marking the answers to questions on one's own lecture course(s) is not yet in place for all written papers, we note that the Department expects all lecturers to read the detailed question-by-question feedback that is provided by the independent examiners to staff and students. An example of this feedback, shown in detail for Q4 of the 2019 Paper GP3, is:

General Paper 3 – Mechanical Properties

Examiner:	**Professor XXX**
Candidates:	**33**
Mean mark:	**65.79%**
Maximum mark:	**94%**
Minimum mark:	**13%**



Detailed comments on the paper are as follows:

Question	**No of Answers**	**Average Mark**	**Highest Mark**	**Lowest Mark**	**Topic**
4	24	9.08	13	4	Microplasticity

General Comments

Overall this paper generated a mean mark near the targeted centre of the 2i class. The spread of marks was relatively large with many very strong scripts, including full marks awarded for some questions, unfortunately some weak scripts were also present. The distribution of attempts was not uniform suggesting either candidates had made premeditated topic selections during preparation for the examination or perceived some questions to be more difficult than others. Statistical analysis does not support there being strong correlation between the number of attempts at a question and the mean mark.

Specific Comments

A generally popular question on strengthening in metallic alloys, which returned the lowest mean mark for the paper. Part (a) requested a comparison of hardening from interstitial C, and substitutional Cr or Mo in iron. Answers lacked the detail sought for full marks in a finals level paper. Parts (b) and (c) developed analysis of strengthening from coherent precipitation but in many cases scripts did not deliver the arguments being sought.

● The Department expects the Part II thesis, which reports on an eight-month full-time project, to follow the format and expectations of a traditional UK PhD thesis, including critical discussion. During Michaelmas Term 2019 explicit written guidance on this was drafted by the Chair of our teaching committee (DMAC), reviewed by the Committee, and will be added early in Hilary Term 2020 to the Part II Handbook, including an indication of what is the typical chapter-by-chapter content of such a thesis. Our Part II Organiser will draw this to the attention of students and supervisors. This structure does not exclude a small amount of ‘narrative’ in the main body of the thesis, for example to indicate to the reader how a critical analysis of the literature and/or of results obtained earlier in the project led to a decision to follow one or more particular paths for the project thereafter. However, in this respect we note that we already require a reflective account of the student’s management of the project to be included in a special final chapter of the thesis.

MS Parts I & II: Professor P. Haynes

We thank Professor Haynes 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 points raised by Prof Haynes:

● We have added strong guidance to our Part II Handbook about an appropriate amount of time to devote to writing the Part II thesis.

● We have modified the timeline for drafting the written papers to allow an additional week for the review stage involving the external examiners and noted the importance of the Chair of Examiners informing the external examiners in writing of the actions taken in response to their feedback on the draft papers.

● As may have been mentioned by our internal examiners during the July 2019 Exam Board, the Faculty of Materials had already discussed and agreed in principle to move to an exam marking process for all FHS written papers where the questions are marked by the lecturer and an examiner, rather than our current practice of marking by two independent examiners for the majority of FHS written papers. At present the lecturer + examiner arrangement occurs only for the two, specialist, Materials Options Papers. To apply this arrangement to all written papers efficiently and effectively we need to move to on-line distribution and marking of scripts that have been digitally scanned and uploaded. This on-line process will be piloted for one or both Materials Options Papers in the Trinity Term 2020 Part I written examinations. Subject to a positive outcome for the pilot we anticipate that for all six 2021 FHS written papers the lecturer will be one of the two markers for the questions on their courses.

Although the direct benefit of marking the answers to questions on one's own lecture course(s) is not yet in place for all written papers, we note that the Department expects all lecturers to read the detailed question-by-question feedback that is provided by the independent examiners to staff and students. An example of this feedback, shown in detail for Q4 of the 2019 Paper GP3, is:

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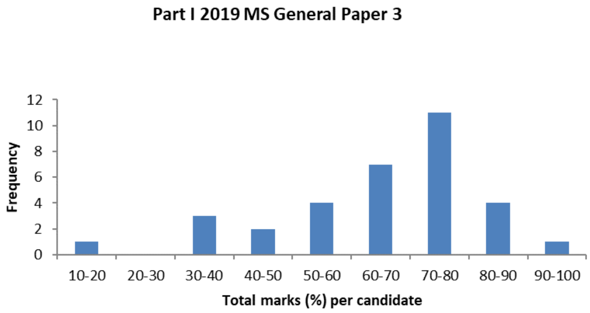

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
4	24	9.08	13	4	Microplasticity

General Comments

Overall this paper generated a mean mark near the targeted centre of the 2i class. The spread of marks was relatively large with many very strong scripts, including full marks awarded for some questions, unfortunately some weak scripts were also present. The distribution of attempts was not uniform suggesting either candidates had made premeditated topic selections during preparation for the examination or perceived some questions to be more difficult than others. Statistical analysis does not support there being strong correlation between the number of attempts at a question and the mean mark.

Specific Comments

A generally popular question on strengthening in metallic alloys, which returned the lowest mean mark for the paper. Part (a) requested a comparison of hardening from interstitial C, and substitutional Cr or Mo in iron. Answers lacked the detail sought for full marks in a finals level paper. Parts (b) and (c) developed analysis of strengthening from coherent precipitation but in many cases scripts did not deliver the arguments being sought.

● On balance the Department remains of the opinion that the examiners of the Part II thesis should not be restricted by pre-allocating specific proportions of the 400 marks available for the Part II project to each aspect of the thesis. Our conventions state "The Part II project is assessed by means of a thesis", and our reasons for not breaking down the 400 marks are (i) that it is the individual eight-month research project, as captured by the thesis as a whole, that we are assessing and (ii) that what may reasonably be expected in each chapter of the thesis will vary from one project to another. We have however asked our Part II Organiser and Chair of Faculty to jointly consider and draft any useful additional detail that could be added to the twelve sections of the fairly detailed guidance on expected content provided in the tabular assessment proforma that forms the first part of the "MS Part II Thesis Assessment Report and Marking Guidelines" document, as provided in our Part II Handbook and to the examiners. The second part of the document, which must be read by students and markers in conjunction with the first part, describes the expectations for the thesis as a whole if a percentage mark in one of the decades of 30 to 39 through to 90 to 100 is to be awarded. In future, when completing the proforma the examiners will be asked to indicate in their brief commentary on **each** of the twelve sections what if any were the major and minor strengths and major and minor weaknesses evidenced by the thesis. As described in the next paragraph, in addition we are adding further guidance on the expected structure and content of the thesis to our Part II Handbook.

> The Department expects the Part II thesis, which reports on an eight-month full-time project, to follow the format and expectations of a traditional UK PhD thesis, including critical discussion. During Michaelmas Term 2019 explicit written guidance on this was drafted by the Chair of our teaching committee (DMAC), reviewed by the Committee, and will be added early in Hilary Term 2020 to the Part II Handbook, including an indication of what is the typical chapter-by-chapter content of such a thesis.

● The Department confirms that integral to its rolling programme of moving to on-line electronic submissions for the majority of assessed coursework elements is the automatic use of a plagiarism filter for such submissions. This is already the case for (i) all assessed first year coursework except the handwritten laboratory notebook entries and the handwritten Crystallography Class scripts and (ii) for the Y2 FHS Practical Course reports and the Y2/Y3 Industrial Visit reports. The anticipated timeline is that for the 2nd, 3rd & 4th years of the programme all examined Materials coursework will be submitted electronically for the first time respectively in 2019/20, 2020/21 and 2021/22. Prior to the 2022 launch of on-line submission for Part II theses we shall continue our current practice of requiring a digital copy of the Part II thesis in addition to the definitive paper copies. These digital copies may be randomly tested for plagiarism and the examiners are able to request such a test on a specific thesis.

● The Department and the Colleges have for many years provided clear guidance to all students on plagiarism, starting in the first term of their first year, including a thorough written guide in the Handbooks, including the Part II Handbook. Nonetheless, as a consequence of the plagiarism detected in a Part II thesis submitted in 2019, all Part II students from 2019/20 onwards are required in addition to complete the University's on-line course on plagiarism. The Department is considering whether to require all ‘freshers’ to complete this course in the first term of their first year too.

● The attention of the Chair of Examiners for 2019/20 has been drawn to (i) Professor Haynes’ request that all examiners and question setters adhere to the Department’s requirement that specimen answers for exam questions should indicate which parts are bookwork and which go beyond this and (ii) Professor Haynes’ suggestion in respect of one sentence summaries about options paper questions, including the importance of consistency in the use of such sentences.

3. Further Points

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

It is noted that, unusually, the raw marks for two Part I papers were scaled down. Given that scaling is deemed necessary by the examiners from time-to-time, it should not be surprising if on some occasions the raw marks are deemed too low and on other occasions too high.

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.

A.O. Taylor, Chairman of DMAC, 16/12/19
P.D. Nellist, Head of Department, 16/12/19