CONFIDENTIAL

EXAMINERS’ REPORTS 2021

MATERIALS SCIENCE (MS)

Internal Examiners’ Reports

REPORT ON PRELIMINARY EXAMINATION IN MATERIAL SCIENCE

Part I

A. STATISTICS

Category	Number			Percentage		
	2020/21	2019/20	2018/19	2020/21	2019/20	2018/19
Distinction	12	n/a	10	27	n/a	25
Pass	27	n/a	29	61	n/a	72.5
Fail	5*	n/a	1*	11	n/a	2.5

*Five candidates resat in September, four of whom satisfied the examiners, and one candidate sat the written papers as first attempt in September, satisfactorily.

Marking of scripts

Scripts are single marked except for borderline cases which are double-marked. Two additional candidates' papers were selected by the chair to be double marked to ensure consistency of marking.

B. NEW EXAMINING METHODS AND PROCEDURES

Due to cancelled 2020 Prelims 2021 were the first exams for the new Prelims course. 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.

With the new course design with no lecture courses shorter than 8 lectures, all course were examined but some questions required knowledge from more than one lecture course. This approach is in line with standard practice in Part I examinations. Lecturers were asked to 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 divisional board to consider.

<u>Materials Papers</u>
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. For the open book format, questions that were very close to previous tute questions or that allowed large chunks of lecture notes to be copied were not useful at discriminating between candidates.

<u>Maths Paper</u>
The average mark on the Maths paper this year was 54.8% which is lower as compared to last year (61.5% in 2019). 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.

<u>Coursework Paper</u>
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.

<u>Computing for Materials Science (CMS)</u>
The marks were reviewed and approved.

<u>Crystallography coursework</u>
The report from the Senior Demonstrator flagged no specific concerns.

<u>Practicals</u>
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.

Two candidates failed the practical classes which is highly unusual. Given the extraordinary circumstances around COVID-19 the moderators agreed to set a practical exam to be taken as a resit paper for these two candidates.

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

Circulation by the Education Support Team to all students and tutors by e-mail, and published onto the Departmental website.

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

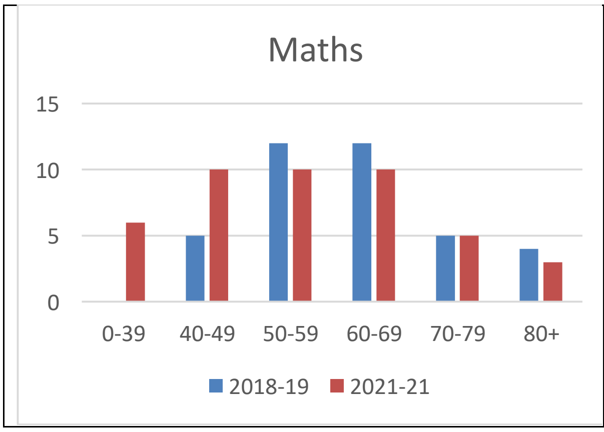
Part II

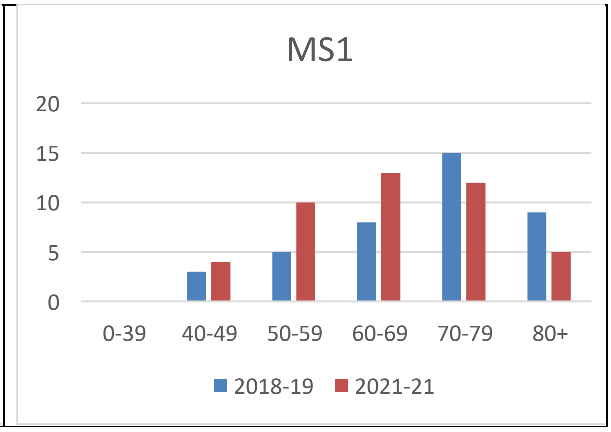
A. GENERAL COMMENTS ON THE EXAMINATION

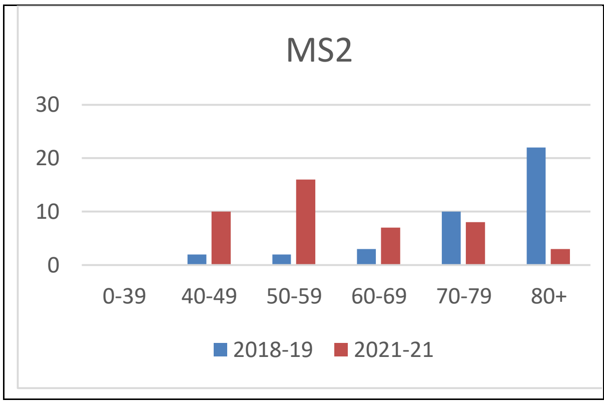
45 students were registered for the examination.

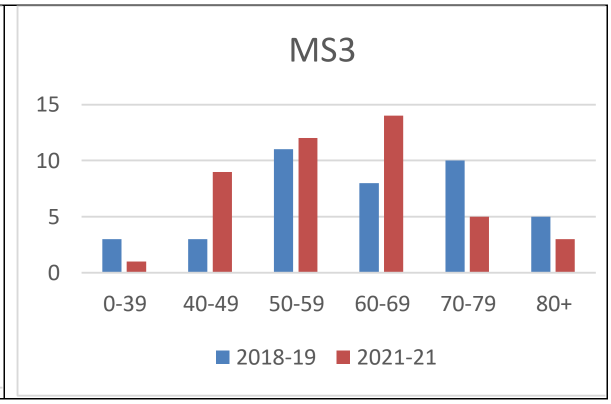
37 candidates passed all papers, without the necessity for compensation, with 3 candidates being compensated; 2 in the Maths paper and 1 in the MS3 papers. Of these 37 successful candidates in June, 12 were awarded Distinctions, all with marks of 70% or more (rounded). 5 candidates failed one paper or practical work, to be retaken in September. One candidate deferred all exams until September due to personal circumstances.

Distributions comparing this years and the 2018-19 are included below. Theo only significant changes are in MS2 were a more conventional distribution is seen in 2020-21 examination.









There were minor errors on MS1,2 and 3, none of which were deemed to have impacted the candidates' performance.

The prize for the best overall performance in Prelims was awarded to Benjamin Zelin, of Trinity College. The prize for the best performance in 1st year Practicals was awarded to James McQueen of Trinity College and Harry Myers of St Anne's College. The Gibbs Prize for meritorious work in Prelims was awarded to James McQueen of Trinity College. Additional prizes for outstanding performance were awarded to Zhen Yap of Trinity College, and Yihong Hu of St Catherine'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 44 candidates who took the whole examination 13 were women and 31 men.

2 of the 12 distinctions were awarded to women.

In view of the small overall number of candidates, it is not sensible to draw conclusions from these data for this year. However long term data (to allow for a bigger data set) on m/f distinction divide should be examined. The 2020-21 mean score for males was 63.4% and for females 60.0%.

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

All candidates took the same papers for the whole examination, with the exception of the one candidate who sat all papers in September. They sat the same Materials papers but the resit maths paper.

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 five applications for special arrangements for the written papers:

[redacted]

There were eight applications to consider regarding Mitigating Circumstances: Notices to Examiners. Four cases (vi-ix) related to technical issues either during the exam or at submission. The moderators confirmed no penalties should be applied to those submitted late as a result. The other four cases (x-xiii) concerned events surrounding the main set of written papers in Trinity term. These cases were considered to have had serious impact. The Moderators considered the cases carefully and a fair course of action was agreed and documented in MCE reports.

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F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

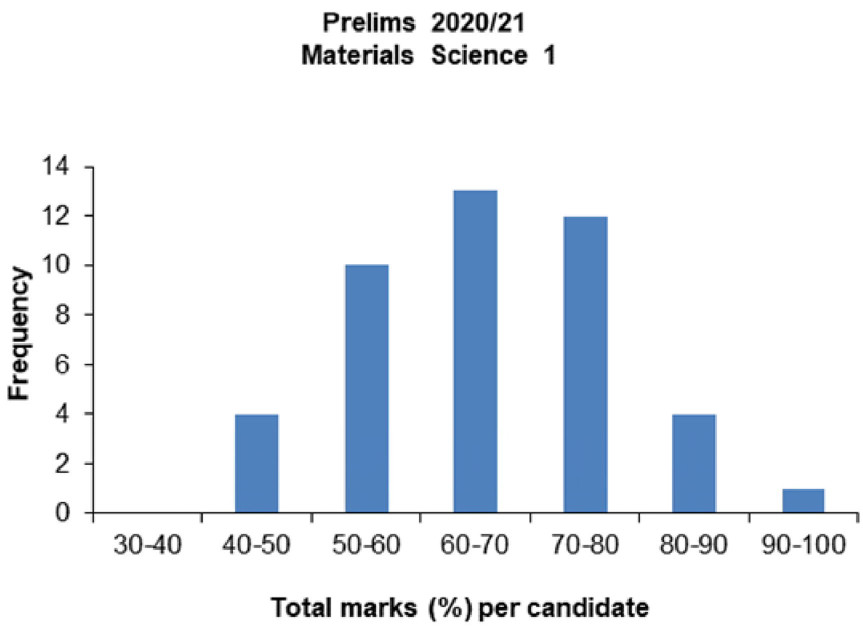
Professor D.E.J. Armstrong (Chair)
Professor L. Bogani
Professor C.R.M. Grovenor
Professor M.P. Moody

MS1 – Structure of Materials

Examiner: Professor Michael Moody
Candidates: 44
Mean mark: 65.4%
Maximum mark: 91%
Minimum mark: 42%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	26	12.46	20	8	Electromagnetic Properties and Devices
2	42	14.19	18	5	Electromagnetic Properties and Devices
3	20	8.70	18	2	Random Processes and Statistical Physics
4	20	10.05	18	6	Random Processes and Statistical Physics
5	11	9.55	18	2	Wave Mechanics, Quantum Theory and Bonding
6	40	15.38	20	5	Wave Mechanics, Quantum Theory and Bonding
7	29	14.38	20	9	The Study of Crystalline Materials by Diffraction
8	31	14.32	19	2	The Study of Crystalline Materials by Diffraction



General comments:

The average mark was 66.5%, however a wide spread can be seen in the distribution with many students scoring significantly higher grades. Popular questions were Q2 and Q6. In particular, it was refreshing to see so many attempts at Q2 from the Electromagnetic Properties and Devices course, given the fact this topic has generally been strategically avoided by candidates in recent Prelims. Candidates had difficulty with Q3 and Q4 from the Random Processes and Statistical Physics lecture course. However, given the fact that this is a relatively new course, and has not been examined since the recent overhaul of the 1st Year curriculum, it may be the case that students were less sure as to the type of questions to expect from this topic and possibly less prepared. However, some candidates were able to achieve high marks on both these questions demonstrating that good scores were achievable. The least popular question was Q5 from the Wave Mechanics, Quantum Theory and Bonding. Aspects of this question did require some lateral thought beyond the information explicitly presented in the course notes, which may have led to candidates looking to what they perceived as safer options. However, again several candidates achieved high marks for this question demonstrating that, although challenging, it was pitched at a reasonable level of understanding of the course material.

Specific Comments:

1) Electromagnetic Properties and Devices. This question was based around the understanding and application of Ampere's Law to predict the nature of magnetic fields. Part a. was generally done well. The derivation of the expression in part b. was done well by many, however, often the assumptions utilised were not explicitly stated. Some candidates took other less straight-forward approaches to deriving this relationship rather than using Ampere's Law. Whilst some were successful with such approaches, more often than not this more complicated route led to confusion. Most candidates had difficulty plotting the relationship between magnetic field and radial distance from centre of the cable. Surprisingly, even those who successfully derived the equation in the previous part of the question had difficulty drawing this graph. Part c was hit-or-miss for most candidates. The most common issue being confusing the relative directions of the magnetic field components.

2) Electromagnetic Properties and Devices. This was the most popular question on the paper. In general candidates found the first part of the question related to Gauss' Law and electrostatic potential straightforward, and the marks achieved in this section formed the basis of many good scores for this question. There was a typo in b(i) whereby the terms (x+a) and (x-a) should have been $(x+a)^2$ and $(x-a)^2$, respectively. However, given a similar derivation had been presented in the notes, nearly all candidates quickly identified this issue and it did not appear to significantly affect on the ability to answer correctly. However, even though many correctly derived the form of the electric field along the y-direction, very few were able to accurately graph its form. To calculate the potential, candidates often attempted more difficult approaches rather than simply using the derivative pf the electric field: $E_y=-dV/dy$.

3) Random Processes and Statistical Physics: Candidates generally found this question challenging. The highest mark of 18 demonstrates that good scores were achievable. However, many candidates gave up on this question early, with part c), worth 8 marks, frequently not even attempted. This was disappointing as some marks were readily available from this section just by carefully setting out the problem. Many candidates spent a disproportionate amount of time on a) i), which was answered well, but only offered 2 marks. Candidates also found difficulty with a) iii). Some attempts were made at part b), however, most students did not adapt their answers for the case of a diatomic molecule.

4) Random Processes and Statistical Physics: Candidates also found the second question on this topic challenging. Marks were readily achieved in part a) and b). However, students had significant difficulty with part c), deriving a probability distribution for speed of molecules escaping effusively from a container. Disappointingly, many candidates did not even attempt this part of the question, foregoing readily straightforward marks for initially setting out the problem.

5) Wave Mechanics, Quantum Theory and Bonding: This was by far the least popular question on the MS1 paper, and likewise one of the most poorly answered. The derivation of the given expression for the expectation energy of an electron in a potential well was at the core of the question. Candidates found this challenging, and some skipped this part of the question altogether. However, once the initial equation was stated, the actual derivation was straightforward implementation of differentials and integration, with several students successfully demonstrating the given expression.

6) Wave Mechanics, Quantum Theory and Bonding: This was one of the most popular questions and generally very well answered. Most candidates who submitted complete answers to every section achieved high marks. The overall average was reduced by candidates who only partially attempted the question. Most common loss of marks was through failing to provide explicit explanation as to why the given respective combinations of operators were conjugate or not.

7) The Study of Crystalline Materials by Diffraction: Another popular question. A recurring issue was caused by the question in part c) stating a specific camera length for the diffraction experiment. This information was included to emphasise that the respective experiments described in this section were undertaken with the same experimental conditions (other than changing the orientation of the crystal being analysed). However, this information was not required to index the respective patterns nor the lattice parameter. While many found the process of indexing the diffraction spots difficult, the most challenging aspect for most candidates was to identify the relative direction of the incident beam.

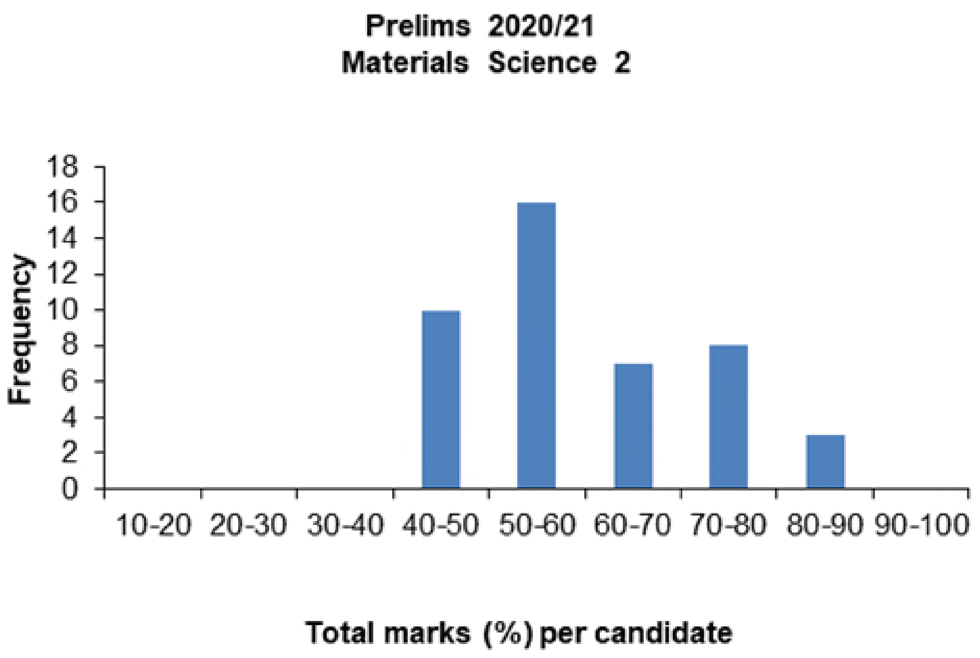
8) The Study of Crystalline Materials by Diffraction: This was a popular question generally answered to a high standard. Marks were most frequently lost in part d) estimating the average distance between nearest Ni neighbours, and more often than not this part of the question was not attempted. In part d) analysis of the provided X-ray diffraction information could lead to the conclusion the analysed system as being either body-centred cubic (bcc) or simple cubic (sc). This caused some confusion. Surprisingly, given the options the majority of candidates deduced sc, rather than bcc which is exemplified more often in the lectures.

MS2 – Properties of Materials

Examiner(s): **Professor David Armstrong**
Candidates: **44**
Mean mark: **58.6%**
Maximum mark: **83%**
Minimum mark: **40%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	32	10.44	17	3	Elastic deformation
2	32	11.19	18	4	Mechanical Properties
3	24	9.81	18	6	Mechanical Properties
4	29	9.97	16	0	Elastic deformation and Mech props
5	25	14.08	20	6	Defects in Crystals
6	40	15.65	20	8	Defects in Crystals
7	1	3.00	3	3	Structures of Crystalline and Glassy Materials
8	35	10.91	17	1	Structures of Crystalline and Glassy Materials



General comments:

The paper produced a good range of marks and seemed to differentiate between stronger and weaker candidates. The mean was reduced from 76% (2019) to 57% through a concerted effort to produce questions which would stretch the students. Good students could still score very highly. Many students struggled with dimensions (nm, mm, cm etc) and radius vs diameter. 7 questions had a good number of answers. 1 only had 1 attempt. The reason for this is not clear – it was a question where the concepts were covered in lectures and tutorials, on a different materials system. Open book seemed to work well. In a few places candidates reproduced lecture notes word for word but often this did not answer the question asked and did not score well. In a few places answers were wildly wrong where google had clearly sent them in a very, very wrong direction. If they had engaged with the course this should have been clear to them from the question context.

Specific Comments:

1) Elastic deformation. Part a) was standard book work. Many candidates dropped marks as although explicitly asked to explain the derivations many did not include any description relying just on equations. Most knew the radial stress was zero but few could explain why. Part b) was quite a complicated Mohrs circles question involving torsion and compression on a pressurized tube. They have seen both cases individually but never combined together. The best candidates scored highly, the weakest did not. Weak candidates could either not deal with the torsion or could not combine the two stress states and solve. Many candidates made errors with dimensions and units (mm vs cm etc).

2) Mechanical properties. A) very standard work similar to a tute sheet question requiring load and displacement to be converted to engineering stress and engineering strain, and obtain E, yield stress, .2% proof stress and UTS. Good candidates scored highly. Some weaker ones, had issues with dimensions and units (microns caused issues) to calculate stress and strain and did not know how to calculate a proof stress or what UTS was. As this was all on the tute sheet it was rather disappointing. Some candidates did not seem prepared to plot a graph (no graph paper or ruler) and relied on bad sketches. B) some good ideas from most on the use of DIC or strain gauges and a more appropriate load cell. C) some good answers but many did not include any discussion on changes in work hardening behaviour. Some poor answers confused modulus and yield stress. Many confused or misread the use of microns and nm and had properties the wrong way round. D) mostly well answered on instability of nano grains at high temps.

3) A) three different materials systems needing a discussion about how mechanical properties are modified. Most did well on Fe-N, the composites proved more challenging. B) a simple solid solution phase diagram. Some very clear answers – but many tried to form a ppt strengthened system. C) comparing b to the al-cu system. Most could describe the ppts but not all could give a sensible heat treatment.

4) A) a difficult beam bending question. A) i) most could have a good attempt at getting the reaction forces. ii) The loading conditions (point moment and distributed load) were intentionally complex and left in terms of X and Y. Similar example are on the tute sheet but not combined together. Some students could work it through and plot the graphs for full marks. Weaker students could not get very far – the weakest unable to deal with either a distributed load or point moment. This approach seemed to differentiate between candidates well. Part b used the same loading conditions with pre notches and candidates were asked to find were the beam failed. Many did not notice one notch was in compression and would never fail. A typo in the question (dimension in cm rather than mm) meant that under the loading conditions no notches were bigger than the critical size. Some candidates got full marks for identifying this. Others worked out which notch had the largest K value and used this to predict failure if the load was increased - again this could obtain full marks. Weaker candidates did not know how to calculate the stress at the notch using the moment.

5) A well done question part a candidates had to determine dislocation types – most knew the approach but attention to detail let some down. B) candidates scored well on the first two parts. Some struggled with part iii) but nearly all could do iv)

6) A very popular question. Possibly too similar to one on the tute sheet. Well done by most candidates. Most issues came in part iii) which required some thinking to set the problem up. Some candidates scored full marks on the question.

7) Only attempted by one question and not well answered. The question was designed to require students to look information up (not in lecture notes) and this may have put some students off.

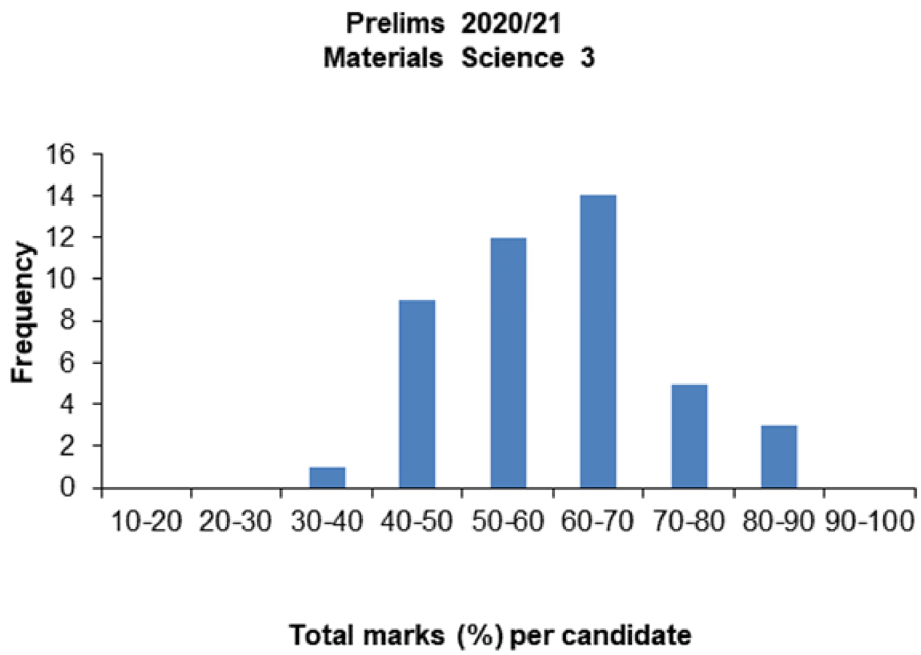
8) This question on HR rules and order disorder reactions was quite book work heavy. Many students copied the same words and pictures form lecture notes without thinking about if it answered the question (often it did not). This led to a good distribution of marks where stronger candidates had worked to answer the question rather than just reproduce lecture notes.

MS3 – Transforming Materials

Examiner(s): Professor Chris Grovenor
Candidates: 44
Mean mark: 58.9%
Maximum mark: 81%
Minimum mark: 36%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	24	11.92	17	6	Electrochemistry
2	26	11.35	18	4	Thermodynamics
3	29	10.00	17	3	Electrochemistry
4	42	12.55	20	3	Microstructure and Processing of Materials I
5	36	14.92	20	6	Thermodynamics
6	22	13.55	20	6	Microstructure and Processing of Materials II
7	15	11.33	20	3	Introduction to Nanomaterials
8	20	9.50	14	2	Microstructure and Processing of Materials I



General Comments

This paper had an average score similar to MS2 and a little lower than MS1. Some students scored highly, but there were quite a lot of scripts with marks in the 40s and 50s. One candidate scored only 36 and this was compensated to a pass by scores in other paper following normal Prelims regulations. Several candidates failed to submit 5 questions, in one case only 3 (but still achieved a passing mark).

The distribution of attempted questions was fairly uniform, with 15 answers being the lowest value for Q7 on Nanomaterials (where some of the lecturing was delivered very late in the year).

Specific Comments

1) An electrochemistry question written by the examiner to encourage the students to use concepts from the lectures to explain phenomena related to electrochemical processes. Attempted by over half the candidates, generally quite successfully. The least well answered section was on the effect of Cd in Pb on changing the exchange current density.

2) This was a reasonably popular question on the thermodynamics of the CO/CO2 system. It required quite a lot of calculation, but the principle was straightforward. There were several very good answers and a few where the students hardly got started.

3) A reasonably popular question on the electrochemistry of the zinc/air battery, with a wide spread of marks. Some students could not write down the cell equations (although several of them are in the lecture slides), and others obtained almost full marks. The section on plotting the Tafel line was poorly done, as was the correct form of the Nernst equation in part (d).

4) This was the most popular question and had a high average mark. It required the students to plot a simple binary phase diagram from information given, and the form of the peritectic caused the most problem (as it often does). There were several perfect answers, and a few where the students did not seem to know how to start.

5) This was another popular question on thermodynamic, this time deriving and manipulating Helmholtz and Clapeyron equations. Because this was straightforward bookwork, it was not surprising that the mark average was the highest on the paper.

6) This was a question on controlling microstructures based on the Trinity Term lectures of the Microstructures course. The students produced quite good answers on all parts of the question, although the sections on Al and Fe alloys scored less well than the polymer and ceramics parts, mainly because some students did not address directly what the question asked about refining microstructure. There was a typo in the script (the Si was left in what was meant to be Al 12wt%Si in c(i)), and credit was given to students who made a sensible guess about what alloy to discuss.

7) This was a rather less popular question on nanomaterials, but the average mark was still fairly high. There was some delay in the delivery of this course in TT, and so the students did not have very much time to revise this material. The poorest answers were for part c where the students had to interpret AFM images.

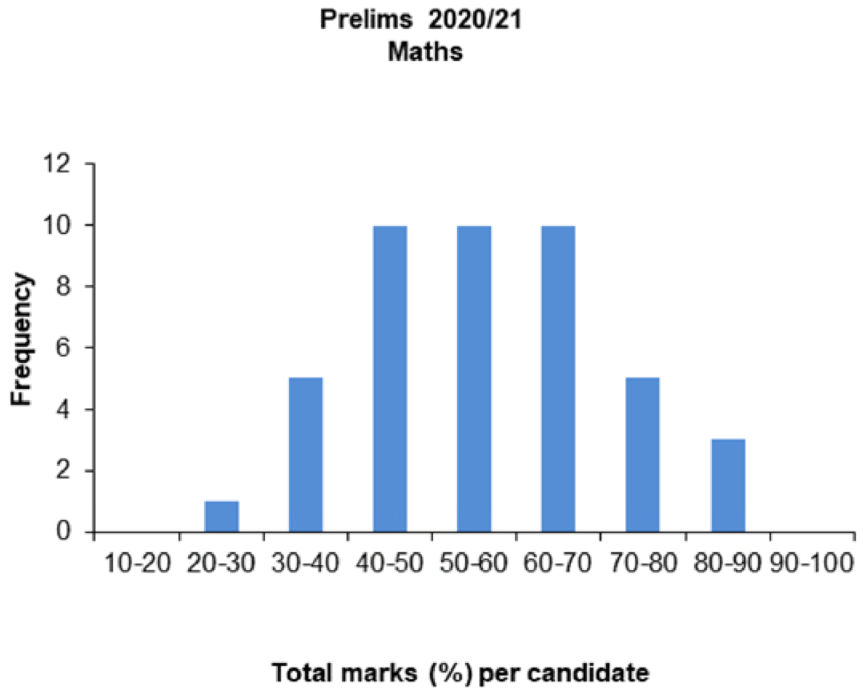
8) This question on phase transformations (microstructures) had the lowest average mark and was not very popular. In part a, very few students wrote down the critical equations for r^* and ΔG^* for solidification and then looked carefully at the data they were offered. In part b, only one student recognised a monotectoid (hard), but the attempts to describe a simple solidification and precipitation cooling sequence at 10% Zn were generally very disappointing.

Mathematics for Materials Science

Examiner(s): **Professor Lapo Bogani**
Candidates: **44**
Mean mark: **54.8%**
Maximum mark: **83%**
Minimum mark: **22%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	%	Highest Mark	Lowest Mark
1	44	6.93	87	8	0
2	40	5.53	69	8	1
3	41	6.10	76	8	0
4	42	5.98	75	8	1
5	39	5.56	70	8	0
6	42	4.69	59	8	0
7	41	3.56	45	8	0
8	43	7.30	91	8	4
9	40	5.28	66	8	0
10	44	6.66	83	8	2
11	31	12.35	49	25	0
12	35	9.37	38	22	2
13	21	11.76	47	24	2
14	10	9.60	38	18	2
15	42	15.26	61	22	1
16	17	12.35	49	25	3



General comments:

The exam paper was free of errors and no questions were raised in relation to the paper during or after the examination. The average mark was 55%, lower than the last in-person examination, and very significantly lower than previous peaks of >80%. This outcome was desired, and it is in line with the recommendation to set an exam paper slightly more challenging than the 2018 and following ones, in order to better align with the results of the finals. The marks are normally distributed with a roughly Gaussian shape, and there appears to be a wide spread of outcomes, which is also reflected in the scores of other prelims papers. It is important to notice that all PartA questions and two PartB questions found at least a student able to work them out completely. The averages per question are currently given with two decimal digits, but the standard deviation of the marks for each question indicates (roughly) a ±0.5 deviation bar for PartA. For PartA questions, the average marks were all above 40%, with the lowest one being 44%. In Part A, Q7 was the one with the lowest scores, for which most students did not seem to know how to approach the problem, especially for section b of the question. PartB questions saw two problems, Q12 and Q14, placed at the low end of the marks, close to the 40% threshold, within statistical uncertainty. The worst performance is observed for Q14, which was also attempted by a mere 10 students, with very low average marks and the lowest highest mark of PartB. Q15 was by far the most attempted and the one with highest marks (average mark 61%). The parts that were left unanswered were mostly those that are not standard bookwork.

It is very clear that the most popular and neatly-answered questions were those on matrices and determinants, geometry, and deformations of solids. These questions were popular (for partB), it was clear that they remained challenging (only a couple of students achieved full marks, for one of them), but it was also clear that the overwhelming majority of students felt confident at least in the basic parts, and felt at ease with the subject. Overall, this exam appeared rather challenging, and the level of maths required appears compatible with the necessities of later courses of the second and third year.

The resits saw the presentation of very straightforward answers, with a tuning of the difficulty level, so that it was comparable to the first examination, and not those of previous years. Out of five candidates, one candidate did not reach 30%, while all other candidates were decidedly above 50%, and one even managed to score above 70%.

Specific Comments:

1) Average: 87% Standard question on the evaluation of partial derivatives, fairly straightforward. Most students were able to provide correct answers. They did really well here.

2) Average: 69% Standard question on the evaluation of partial derivatives, although slightly less straightforward. Most students were able to provide correct answers.

3) Average: 76% Standard question on calculating an integral. Slightly more challenging than previous years. Most students were able to provide correct answers, but many failed to consider the constant term in the indefinite integral.

4) Average: 75% Very standard question on complex numbers and their representation on the Argand diagram. Most students found part a relatively straightforward, but a surprising number failed to answer to part b correctly. There is a clear improvement with respect to previous examinations.

5) Average: 70% Question on a circuit that had been considered during the coursework, and its identification. Most students were able to provide correct answers, but a surprising number failed to answer to part b correctly.

6) Average: 59% Question with two limits, with a useful hint provided. Most students were able to provide correct answers for part a, but Part b saw fewer answers. This part shows some trouble with the evaluation of limits. This is consistent with the results of previous years on the same sort of questions.

7) Average: 45% Standard question on the evaluation of series, requiring practice with calculus. Some students did not know how to proceed, and many provided only partial answers. Only in a couple of cases we have complete correct answers. Almost no student attempted part b, which should have been very straightforward after part a, indicating that they show little familiarity with the topic. This is consistent with previous examinations, when similar questions are considered.

8) Average: 91% Basic question on geometry, vectors and matrices. They did really well here.

9) Average: 66% Question on geometry but with a more physics flare to it. Apparently this made it less straightforward and very few students attempted part b.

10) Average: 83% Question about matrix calculation. They did really well here.

11) Attempts: 69% Average: 49% Straightforward and clear-cut question about partial derivation and changes on coordinates. The question was very popular, and most students could solve parts a and b. This coincides with the results of part A, where the students display confidence in this topic. Some students could make it from top to end.

12) Attempts: 78% Average: 38% Question the evaluation of integrals, only thinly disguised as a physics problem. The question was popular. Many students attempted part a and part b, but very few people moved on to the following parts, leading to lower marks on average. The students display some confidence in this topic, but quickly had trouble as integrals were becoming progressively more difficult.

13) Attempts: 47% Average: 47% Question about finding the trajectory of a pendulum. Relatively few students chose this question, and very few could progress to parts b and c.

14) Attempts: 22% Average: 38% Students found this question very difficult, as it included double integrals and the formulation was decidedly less straightforward than question 11, involving the dynamics of a suspended beam. No student went even close to full marks on this question. The question was very unpopular, seeing only 1/5 of the candidates attempting it, and only one student moved beyond part a.

15) Attempts: 93 % Average: 61% This question was extremely popular, in agreement with the ease that the students display in the topic of vector and matrix calculations, and geometry. The question displayed a gradually increasing level of difficulty, and most students could only make 3 parts, and only a couple of students reached the final part.

16) Attempts: 38% Average: 49% The final question was less popular, as it involved the gradient of a function and the students showed considerably less confidence with it. Just a couple of students moved to parts e and f.

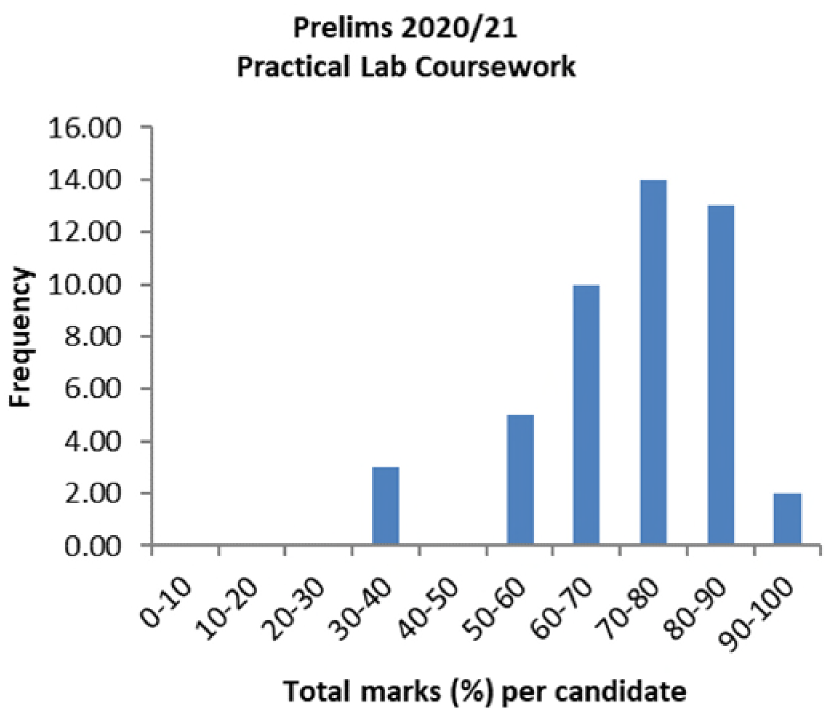
Practical Lab Coursework

Candidates: **45**
Mean mark: **71.9%**
Maximum mark: **91%**
Minimum mark: **34%**

Detailed comments on the coursework are as follows:

Lab No Lab Book Assessment (/3)	Average Mark	Highest Mark	Lowest Mark
1P3	2.1	3.0	0.5
1P4	2.0	2.75	0.5
1P5	2.7	3.0	1.5
1P6	2.0	2.7	0.6
1P7	2.5	3.0	1.0
1P8	2.2	3.0	0.1
1P9	2.7	3.0	1.5
1P10 (not assessed)	n/a	n/a	n/a

Lab No Lab Report Assessment (/13)	Average Mark	Highest Mark	Lowest Mark
1P6	7.4	12.5	1
1P8	9.8	13.0	2.0



Report from the Practical Class Organiser for 1st year Practicals 2020-21

I have reviewed the marks from the 1st year Practicals 2020-21. This year, due to the Covid19 restrictions, most of the practicals were offered online, as a pre-recorded video accompanied by the datasets acquired for the students to work on. 1P1b, 1P2 and 1P3 were done in person in the lab. However, the high number of students in self-isolation during MT resulted in 12 students missing 1P1b, 7 missing 1P2 and 4 missing 1P3. They were offered the online version instead. In addition, 1 student was not in Oxford and did all practicals online. All practicals were online in HT and TT. During TT, some of the students who missed 1P1b (Intro to Optical Microscopy) had the chance to do it in the lab. In addition, a reduced version of the 1P4 (Metallography) practical was offered in the lab for all students, so that they could gain the relevant skills. The lab notebook marks from 1P10 were not received due to the SD's personal situation and have been replaced by the average lab notebook mark from the rest of the practicals.

The lab notebooks were assessed for 8 practicals (although marks were not submitted for 1P10). Out of a maximum of 3 marks, the average was 2.3, increasing from 2.0 last year.

This year, there was a broad range of overall average marks ranging from 34 to 91%, while last year they ranged from 48 to 91%. The average mark was 71.9% (vs 68% last year). This year there have been two students who obtained an overall mark below the 40% threshold needed to pass the Prelims. I have reviewed their lab notebooks and reports, and these are my comments:

- [redacted]
- [redacted]

[redacted]

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 10% (female students achieving higher marks on average).

Penalties: I have looked at the suggested penalties and am recommending that these are accepted in their entirety. Medical certificates were supplied by some students to cover late submission and penalties waived accordingly in line with the guidance in the course handbook. There are some cases deserving further comments:

- No penalties were assigned for late submission of lab notebooks

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

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

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

- None that hasn't been dealt with by the SDs involved and subsequently sorted.

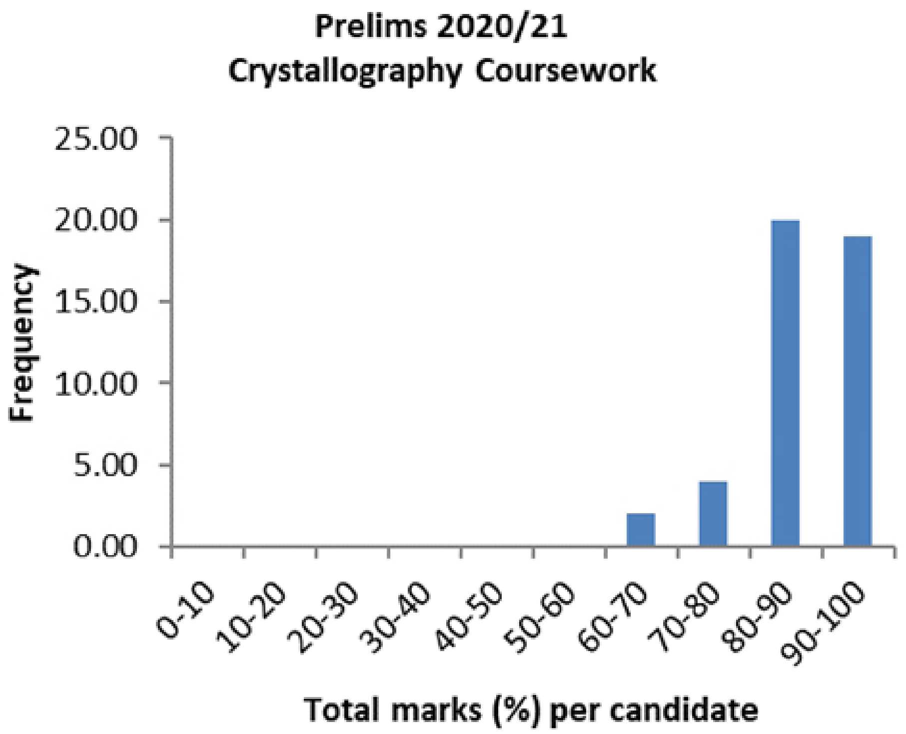
Practical Class Organiser – Sergio Lozano-Perez
June 2021

Crystallography Class Coursework

Candidates: **45**
Mean mark: **86%**
Maximum mark: **95%**
Minimum mark: **61%**

Detailed comments on the coursework are as follows:

Demo No	Average Mark	Highest Mark	Lowest Mark
D2	9.0	10.0	7.2
D3	7.6	9.6	0.0
D4	8.8	10.0	2.0
D5	8.4	9.4	6.5
D6	9.4	10.0	7.4



Report from the 1st year Crystallography Class Organiser for 2020-21

This year the crystallography classes were supervised through Teams by Ed Darnbrough, Peiyu Chen, Victoria Strutt and Thomas Slater.

Following on from last year the course with the six classes supports both the Crystallography lectures and Structures of Crystalline and Glassy Materials course. The content and focus of each class has stayed the same but considerable work was put into adapt the delivery and route of submission of work by the students to account for distance learning. This resulted in students filling in electronic worksheets and supplementing them with photos of sketches/diagrams as required. It should be noted that no marks were taken from students due to late submission, but 17% of assignments failed to be upload on time. To support the students while they conducted this work the sessions were run a 3 hour 'live' classes where students were put into breakout groups of 6, akin to the tables they would have had in previous years, which the supervisors were able to drop in and out of to check on and respond to questioning. The students who engaged in the group nature of the work had a better experience of the classes as a whole.

Each practical is worth 10 marks with those marks distributed sensibly across the questions posed. The guided nature of the class, along with the availability of lecture notes and textbooks, means a score of 7 or below on any one practical indicates that the student struggled with that practical. The online nature of the class material means that any student with a disability that may inhibit spatial perception or spatial reasoning will likely struggle, an attempt was made to provide a number of digital 3D models but the success of this is unknown.

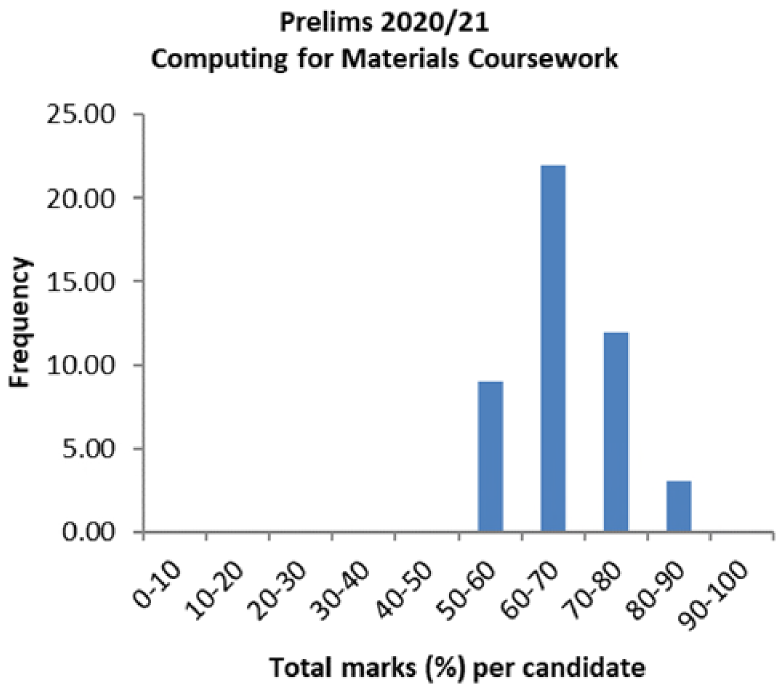
I attach the complete spreadsheet for crystallography practical marks for 2020/21. The large majority achieved good marks in the classes, with a final average grade of 86% across the year group. All students scored a final grade between 62 to 95%, with 17 scoring an average of over 90%. This I believe reflects well on the classes as being a learning environment rather than a testing one. For context, last year the marks ranged from 76 to 96%, with a mean of 89%. This suggests the change in delivery did not negatively affect the student's ability to complete the work. Conversations with students suggests that when in an active breakout group they learnt a great deal which supported the other teaching by practicing theory and discussing it thoroughly with their peers. Absentees were difficult to record for these online classes, but were students were not online during the live session emails were sent in concern to Tutors and in all but two cases resulted in the student joining before the end and submitting work.

Ed Darnbrough
Crystallography Class Organiser
2020-21

Computing for Materials Science

Candidates: **45**
Mean mark: **67%**
Maximum mark: **82%**
Minimum mark: **51%**

Detailed comments on the coursework are as follows:



Report from the 1st year Computing for Materials Science convenor for 2020-21

This year the course was held remotely. Students were offered four three-hour online sessions in which they could receive help with the class material. For the projects students were provided with a dedicated email address to ask questions, and the junior demonstrators ran a series of online drop in sessions.

Almost all candidates were able to complete the assessed programming exercise, and submitted working code. The variation in the marks were therefore mainly due to the submitted reports. A number of candidates produced correct results, but did not consider the physical meaning of these results. Many candidates submitted reports that did not follow the clear guidance provided in the project description. For example this states what is required of an introduction and conclusion.

Jonathan Yates
Computing for Materials Science course leader
2020-21

Examination Conventions 2020/21
Preliminary Examination in Materials Science
(revisions reflecting the changes introduced for COVID-19 pandemic)

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 2020/21; the entries in green font reflect the special measures and changes adopted to allow for the COVID-19 pandemic. The Department of Materials' Academic Committee (DMAC) is responsible for approving the Conventions and considers these annually, in consultation with the examiners. The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. These Conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The Examination Regulations may be found at: www.admin.ox.ac.uk/examregs.

The paragraphs below indicate the conventions to which the examiners usually adhere, subject to the guidance of other bodies such as the Academic Committee in the Department, the Mathematical, Physical and Life Sciences Division, the Education Committee of the University and the Proctors who may offer advice or make recommendations to examiners.

The examiners are nominated by the Nominating Committee* in the Department and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. In Prelims the examiners are called "moderators". Formally, moderators act on behalf of the University and in this role are independent of the Department, the colleges and of those who teach the MS M.Eng. programme.

2. RUBRICS AND STRUCTURE FOR INDIVIDUAL PAPERS

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

Written Paper Format

Materials Science papers 1-3 in Trinity Term 2021 will be sat as open-book exams via the online assessment platform. The mode of completion of each of these papers will be fully handwritten answers which will need to be scanned and uploaded. (It is possible to apply for an alternative mode on the grounds of disability or medical condition as an exam adjustment.) For these online exams, there will be a technical time allowance of 30 minutes per exam for upload and technical difficulties.

The structure, content and duration of the online open-book examination papers has been reviewed carefully by the examining board of moderators. In the main, the Prelims examination questions that are used for revision purposes are already designed to assess understanding, rather than memory-recall of facts. This means that only some minor changes to the traditional 'closed-book' papers have been necessary to make them suitable to be sat as open-book.

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.

* for the 2020-21 examinations the Nominating Committee comprised Prof Nellist, Prof Marrow & Dr Taylor.

The Prelims paper on Maths for Materials Science will be sat as a closed-book exam. Depending on circumstances, this will either be sat as an in-person exam in Oxford, or as an online exam via the assessment platform, with remote invigilation. The mode of completion will be fully handwritten answers which, if online, will need to be scanned and uploaded. Confirmation and further details on the precise nature will be provided by the end of Hilary Term. The Maths for Materials Science paper consists of two sections, candidates are required to answer all questions in Part A and 4 from Part B. The total marks available for this paper are 180; the mark achieved then being weighted by a factor of 0.555' such that the paper contributes a maximum of 100 marks to the Preliminary Examination.

Examiners proof read the final 'camera-ready' pdf version of each examination paper. Great care is taken to minimise the occurrence of errors or ambiguities. Despite this care, on occasion an error does remain in a paper presented to candidates: if a candidate thinks there is an error or mistake in the paper, then they must state what they believe the error to be at the start of their answer to that question and if necessary, state their understanding of the question. The examiners will then consider the validity of the error and assess the impact of the error on candidates' choice of questions and on the answers written by those who attempted a question that contained an error, and will take this impact into account when marking the paper.

Coursework paper

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

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

Candidates are not permitted calculators in the Mathematics for Materials Science examination.

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. However, to mitigate against any difficulties faced by the candidates as a result of the move to open-book examinations, the moderators propose to compare the overall mean and spread of marks at paper level with those from previous years, and may adjust by scaling where it is judged to be necessary.

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

If the candidate lists more than the prescribed number of questions then questions will be marked in the order listed until the prescribed number has been reached. The examiners will NOT mark questions in excess of the prescribed number. If fewer questions than the prescribed number are attempted, (i) each missing attempt will be assigned a mark of zero, (ii) for those questions that are attempted **no** marks beyond the maximum per question indicated under section 2 above will be awarded and (iii) the mark for the paper will still be calculated out of 100 for MS1, MS2 & MS3 and out of 180 for the Maths for Materials Science paper.

3.6 Late- or non-submission of elements of coursework

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

The Examination Regulations prescribe specific dates and times for submission of the required elements of coursework to the Examiners (1. A set of five reports of crystallography coursework as specified in the MS Prelims Handbook (normally each individual report within the set has been marked already as the crystallography classes progress - penalties for late submission of an individual crystallography report are prescribed in the MS Prelims Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions.); 2. Two full reports of practical work as specified in the MS Prelims Handbook plus the student's laboratory notebook entries for the Prelims Practical Course (normally each individual report and laboratory notebook entries for each of the specified practical classes have been marked already as the Practical Course progresses - penalties for late submission of an individual practical report are prescribed in the MS Prelims Handbook and are applied prior to any additional penalties incurred under the provision of the present Conventions); 3. Project work for Computing in Materials Science as specified in the MS Prelims Handbook.) Rules governing late submission of these elements of coursework and any consequent penalties are set out in the 'Late submission and non-submission of a thesis or other written exercise' clause of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations (Part 14, 'Late Submission, Non-submission, Non-appearance and Withdrawal from Examinations' in the 2020/21 Regulations). A candidate who fails to submit an element of coursework by a prescribed date and time will be notified of this by means of an email sent on behalf of the Chair of Moderators.

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

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

b) Under para 14.9. In the case of submission on or after the prescribed date for the submission and within 14 calendar days of notification of non-submission and without prior permission from the Proctors: subject to leave from the Proctors to impose an academic penalty, for the first day or part of the first day that the work is late a penalty of a reduction in the mark for the coursework in question of up to 10% of the maximum mark available for the piece of work and for each subsequent day or part of a day that the work is late a further penalty of up to 5% of the maximum mark available for the piece of work; the exact penalty to be set by the Moderators with due consideration given to the circumstances as advised by the Proctors. The reduction may not take the mark below 40%.

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

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

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

Penalties for late submission of individual practical reports and individual crystallography class reports are set out in the 2020-21 MS Prelims Handbook and are separate to the provisions described above.

The consequences of failure to submit individual practical reports or individual crystallography reports are set out in the MS Prelims Handbook (sections 10.6 and 11 of the 2020/21 version) and are separate to the provisions described above. In short, normally this will be deemed to be a failure to complete satisfactorily the relevant element of Materials Coursework and will therefore constitute failure of the Preliminary Examination as a whole, as stated in the Special Regulations for the Preliminary Examination in Materials Science.

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

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

This is not applicable to the Prelims examination.

3.8 Penalties for poor academic practice

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

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

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

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

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

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

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

Honour code for open-book and closed-book remotely invigilated online exams

“The University’s honour code interacts with and must be read and understood in conjunction with other regulations and policies including:

- the University's disciplinary regulations concerning conduct in examinations;
- the University Student Handbook, in particular sections 9 and 10; and
- the Education Committee's information and guidance on academic good practice and plagiarism.

The University views cheating, acting dishonestly and/or collusion in an examination as a serious disciplinary offence that may result in disciplinary actions, with the most severe penalty being expulsion from the University without a qualification. In the context of open-book and closed-book remotely invigilated examinations:

- the University considers that accessing the question paper via any other means than directly, via the designated online platform, and/or sharing the question paper with other students, falls within its definition of cheating and of acting dishonestly.
- the University reserves the right to use software applications, such as TurnitIn, to screen submitted work for matches either to electronic sources or to other submitted work.

Expected Standards of Behaviour

Students are expected to act as responsible members of the University’s community.

In the context of open-book examination, this means students are permitted to:

- refer to their own course and revision notes; and
- access offline or online resources, for example textbooks or online journals.

In the context of closed-book remotely invigilated examinations, this means that students are not permitted to refer to any materials beyond those provided as part of the exam paper or that are expressly permitted for that exam.
In both open-book examinations and closed-book remotely invigilated examinations, this means that students are expected to:

- submit work which has not been submitted, either partially or in full, either for their current Honour School or qualification, or for another Honour School or qualification of this University (except where the Special Regulations for the subject permit this), or for a qualification at any other institution; and
- indicate clearly the presence of all material they have quoted from other sources, including any diagrams, charts, tables or graphs. Students are not expected to reference, however if you provide a direct quote, or copy a diagram or chart, you are expected to make some mention of the source material as you would in a typical invigilated exam.
- paraphrase adequately all material in their own words.

Students are required to confirm as part of each submission:

- that the work they are submitting for the open-book examination is entirely their own work, except where otherwise indicated; and
- that they have not copied from the work of any other candidate, nor consulted or colluded with any other candidate during the examination.

Honour Code Pledge
All students will be expected to confirm for each open-book or closed book remotely invigilated examination the following:

- **I acknowledge the University Honour Code** and **I hereby confirm** that the submitted work is entirely my own and I have not (i) used the services of any agency or person(s) providing specimen, model or ghostwritten work in the preparation of the work I submit for this open book examination; (ii) given assistance in accessing this paper or in providing specimen, model or ghostwritten work to other candidates submitting for this open-book examination.”

3.9 Penalties for non-attendance

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

3.10 Penalties for late submission of open-book examination scripts

Candidates should upload their submission within the time allowed for their online examination (inclusive of any additional time for exam adjustments and technical time). Candidates who access the paper later than the published start time (and who do not have an agreed alternative start time) will still need to finish and submit their work within the originally published timeframe or be considered to have submitted late. Candidates who access the paper on time but who submit their work after the published timeframe will also be considered to have submitted late.

Where candidates submit their examination after the end of the specified timeframe and believe they have a good reason for doing so, they may submit a mitigating circumstances notice to examiners (MCE) to explain their reasons for the late submission. The Exam Board will consider whether to waive the penalties (outlined below) for late submission.

The penalties will be applied at the paper level and are as follows:

Time	Penalty
First 5 minutes	No penalty
6 minutes onwards	Fail

Penalties will only be applied after the work has been marked and the Exam Board has checked whether there are any valid reasons for late submission.

4. PROGRESSION RULES AND CLASSIFICATION CONVENTIONS

4.1 Qualitative descriptors

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

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

4.2 Final outcome rules (Distinction, Pass, Fail)

The pass/fail border is at 40%.

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

4.3 Progression rules

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

Failure in one or two written papers may be compensated by better performance in other written papers provided the candidate obtains at least 35% on the failed paper. Failure of three papers precludes compensation. Where compensation is permitted, only those marks in excess of 40 on a passed paper may be used towards compensation and normally this shall be at a rate of 3 marks to every deficit mark to be compensated.

For example, if two written papers are passed and marks of 36% and 38% are obtained in the remaining two written papers then the total for the four written papers must be at least 172 marks {36 + 38 + 2x40 + **3**×(4+2)} for both failures to be compensated

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

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

4.4 Use of Vivas

There are no vivas in Prelims.

5. RESITS

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

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

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

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

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

6. MITIGATING CIRCUMSTANCES NOTICES TO EXAMINERS (MCE)

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

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

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

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

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

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

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

Further information on the procedure is provided in the *Examination and Assessment Framework, Annex E and information for students is provided at* 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 2021 are: Prof. David Armstrong (Chair), Prof. Lapo Bogani, Prof. Chris Grovenor and Prof Michael Moody. 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 2021:

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

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

Part I

A. STATISTICS

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

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

Category	Number			Percentage		
	2020/21	2019/20	2018/19	2020/21	2019/20	2018/19
Distinction	n/a	n/a	n/a	n/a	n/a	n/a
Pass	41	30	33	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

Because of the continuing Covid-19 pandemic and the consequent restrictions on gatherings, the 2021 FHS exams followed many of the new methods and procedures adopted for the 2020 FHS examinations.

Scheduling:
Unlike the 2020 Part I examinations, the 2021 Part I examinations were scheduled at the usual times in the Trinity Term of the third year.

Open book format:
In line with other Oxford exams in 2020 and 2021, the Materials FHS Part I papers were sat remotely by students without supervision. The timed release of papers, and the necessity for students to submit their completed scripts, was handled centrally by the University. Students were free to use all resources to-hand, including their own notes and of course the internet, with the obvious limitation that they could not consult anyone for advice nor plagiarise any source. Students were given an additional 30 minutes to submit their work in the form of digital images of the pages of their hand-written scripts; students whose circumstances merited additional time had correspondingly extended submission deadlines. Penalties would potentially be applied in the event that a student missed the deadline by more than a modest margin, however in fact (after investigation of several cases who reported technical difficulties) no such penalties were applied in Part I.

Unlike in 2020, exam papers were initially prepared in open book format. All meetings of the Examiners were conducted via MS Teams sessions.

As per last year, students were unable to query any typo or error that they might feel existed in a paper; instead they were instructed to note in their scripts so that examiners could account for any such remarks when marking. In fact, there was only one mistake over all 6 papers; GP2 had an error in the units given for one quantity, but this did not affect the candidates' ability to do the question.

Digital marking and scaling
As per last year, students uploaded images of the hand-written scripts (though the platform used, Inspera, provided by the University, was different to last year) which were then available to markers via secure WebLearn within a couple of days. Marking then proceeded analogously to practice in previous years, i.e. double-blind marking and subsequent reconciliation of the mark sheets (via Teams sessions). All digital materials held by Examiners were securely deleted at the end of the marking process. Examiners were required to assess the need for scaling of individual papers as per usual, and in addition, assess any need for scaling for the whole cohort due to the effects of covid-19 on the candidates experience during the entire pandemic: learning, preparation for examinations and during examinations.

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

Last year's Chair and the Chair the year before both suggested modifications to the way the Part I General Papers are marked, so as to relieve the burden on the Examiners. This year's Examiners also found the time available to mark the papers very tight indeed. This was not helped by the delay of a couple of days getting the papers to the Examiners (due to protocols required by the University) and the increase in the number of scripts to be marked (41 candidates this year compared with 30 in 2020 and 33 in 2019). If Faculty remains unwilling to modify the way the papers are marked, could they please consider either a change to the timeline for the marking of the papers or some other modification to relieve the time-pressure on the Examiners.

The Examination environment was clearly an issue for the candidates this year. The Examiners would recommend a return to an invigilated, controlled environment as soon as Covid-19 allows.

Last year's Chair commented that the open book format of examinations had merit in that it prevents too much "rote learning" by the candidates. This year's Examiners agree that we should aim to limit the amount of rote-learning required and aim to be testing understanding. The open book format does have advantages, but the practicalities will need to be clearly thought through if the Examinations are to be sat in a controlled environment – e.g. what quantity of lecture notes and books are they allowed, how to get internet access for all candidates, how to prevent candidates from seeing other candidate's laptop screens etc.

Additionally, the Examiners, including the External Examiners, felt that this year's papers left the students too time pressured to be able to look up information, and so consideration should be given to either the length/content of each question or the duration of the papers. We also recommend that questions are not set with the expectation that candidates need to look up information. Further guidance should be given to both candidates and question setters.

As per last year, the digital submission and marking of scripts proved to be effective and convenient for markers. This year's Examiners would again recommend that the Department considers moving to digital script marking going forward. We were constrained this year (by the software used) to having fully handwritten scripts that were then scanned/photographed and up-loaded. Consideration could be given to the feasibility of having hybrid scripts with a combination of typed and handwritten which is up-loaded as a single document.

D. EXAMINATION CONVENTIONS

Examination Conventions, which included the adjustments for COVID-19, were issued to all of the candidates, sent electronically along with other information in a letter from the Chair of Examiners. The Examination Conventions were agreed by the Board of Examiners and the Department's Academic Committee.

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

There were 41 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. In place of the Business Plan, ten candidates opted to take the Foreign Language Option and one candidate opted to take a Supplementary Subject: the examination for this was cancelled due to the pandemic and the marks weighting adjusted accordingly for this candidate. In addition, candidates completed further coursework in the 3rd year in the form of a compulsory Introduction to Materials Modelling course and either a module on Materials Characterisation (twenty-two candidates) or a module on Atomistic Modelling (seventeen candidates). Two returning candidates sat under old regulations and both took the Business Plan module; one choose the then optional Introduction to Materials Modelling module and one choose the Materials Characterisation option module.

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. One candidate had in fact answered four questions drawn from four different sections. The Conventions state that in such a case, the examiners will mark those questions from the first three sections in the order listed by the candidate on the covering page. However, as the examiners were unable to identify the order by which the questions were answered, it was agreed that in this instance, the marks from all four questions would be permitted but the mark of the lowest scoring question be reduced by 50%.

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

The Business Plans, submitted in the second year, were marked by an Assessor 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 three coursework modules was marked by two Assessors. One of the Examiners further examined a number of representative scripts from both of the option 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 raw overall mean mark for Part I was in the mid-2:1 range at 65.80%. The average raw marks for all papers were in the upper 2:2 and low 2:1 range; paper averages for GP2, GP3 and OP1 were below 60%. (GP1 64.12, GP2 58.77, GP3 58.98, GP4 62.00, OP1 59.15, OP2 62.39). The raw paper mean mark was 60.90%. The Examiners looked closely at the marks for each paper in turn and were not minded to apply a scaling to any of the papers on the basis that they were of an inappropriate level of difficulty. Examiners also assessed the overall marks to determine whether a "covid-19–scaling" should be applied to the full cohort. Looking at the mean coursework marks for Part I, it was noted that these were in line with mean coursework marks in previous years, suggesting that the cohort was of a similar standard to previous years. However, the mean paper marks for this cohort were below those from previous years. It was deduced that the changes in teaching practice, ability of the candidates to adequately prepare for examinations, and the change in format of the examinations due to the pandemic, had adversely affected the resultant paper marks. It was therefore agreed to scale the marks for each of the papers by +5 marks, bringing the scaled paper mean mark to 65.90% (bringing all of the individual mean paper marks into the 2:1 range) and the scaled overall mean Part I mark to 67.07%.

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 67.47%, F 63.69% (Overall 65.90%)
Coursework Averages – M 70.31%, F 70.84% (Overall 70.73%)
Overall Part I Averages – M 68.10%, F 65.48% (Overall 67.07%)

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 ±8.56% points for the male candidates and ±7.50% points for the female candidates. Females performed better in the coursework than written papers.

Students with SpLDs were given time extensions in the open book, remote exam format in much the same fashion that they would have in a normal year.

	Overall mark		Written Examinations		Coursework	
mark (%)	Male	Female	Male	Female	Male	Female
30-40	-	-	-	-	-	-
40–50	-	-	-	-	-	-
50–60	3	5	4	6	-	-
60–70	12	7	12	7	12	8
70–80	8	5	6	4	12	9
80–90	1	-	2	-	-	-
90-100		-	-	-	-	-
Totals	24	17	24	17	24	17

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

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

D. COMMENTS ON PAPERS AND INDIVIDUAL QUESTIONS

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

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

Medical certificates were received from four candidates to cover partial absence from practical labs and late submission of reports. The examiners considered and approved the proposal from the Practical Class Organiser to waive the penalties.

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For coursework, two applications for consideration of Mitigating Circumstances: Notices to Examiners were received: one related to Industrial Visits and the other to Introduction to Modelling in Materials Science. Case v was considered to have had moderate impact, case vi was considered to have had only minor impact. The examiners considered both cases carefully and a fair course of action was agreed. This was documented in MCE reports to be made available to examiners for Part II.

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For the written examinations, twenty-eight applications for consideration of Mitigating Circumstances: Notices to Examiners were received. Cases xiv, xv, xx, xxi, xxv, xxviii and xxx were considered to have had serious impact, cases vi, x, xii, xviii, xxiv, xxvi and xxxii were considered to have had moderate impact while cases vii, viii, ix, xi, xiii, xvi, xvii, xix, xxii, xxiii, xxvii, xxix, xxxi, xxxiii and xxxiv were deemed to have generated only minor impact. The Examiners considered each case carefully and a fair course of action was agreed. This was documented in MCE reports to be made available to Examiners for Part II. MCEs submitted to cover late submission of written papers due to technical reasons were rated as minor and no penalties were applied.

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F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

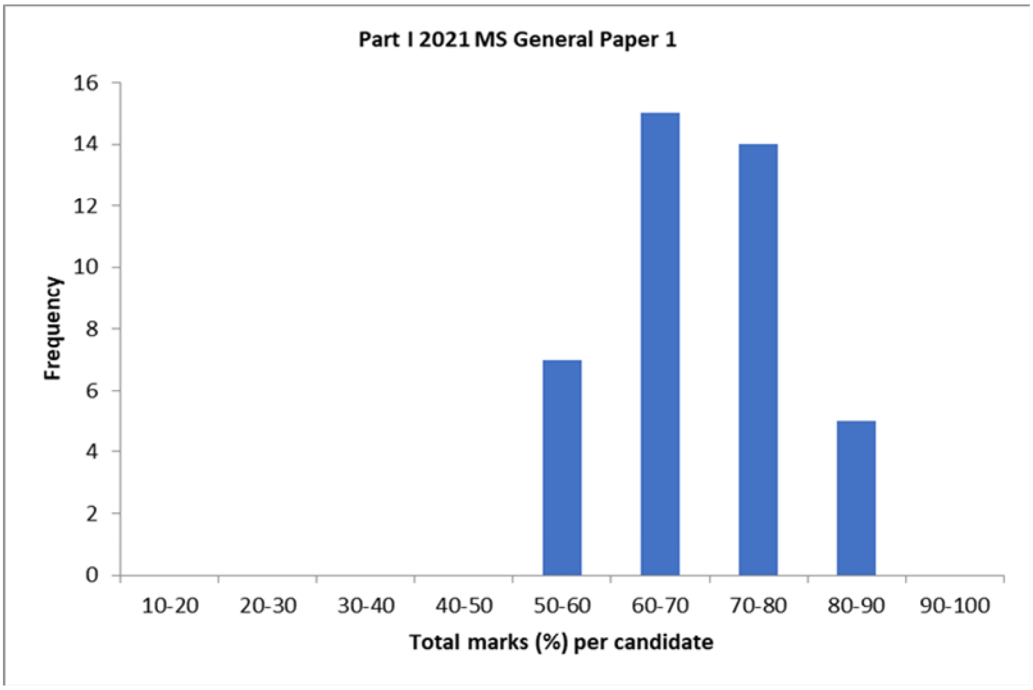
Prof. H.E. Assender	Prof. K.A.Q. O'Reilly (Chair)
Prof. N. Grobert	Prof. P.D. Nellist
Prof. R.I. Todd	Prof. J.M. Smith
Prof. G. Williams (External)	Prof. P.D. Haynes (External)

General Paper 1 – Structure and Transformations

Examiner: **Professor Nicole Grobert**
Candidates: **41**
Mean mark: **69.12%**
Maximum mark: **89%**
Minimum mark: **53%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	9	11.17	16.5	7.5	Phase Transformations
2	27	10.87	17	4	Phase Transformations
3	35	10.74	15.5	4	Corrosion
4	23	11.93	17	4	Corrosion
5	26	13.12	16.5	8.5	Microstructure of Polymers
6	29	14.98	19.5	8	Powder Processing
7	30	14.40	18.5	10	Surfaces and Interfaces
8	25	14.68	20	5	Ternary Phase Diagrams



General Comments

The questions for the Structure and Transformations paper, GP1, followed the Open Book guidelines. They consisted of a balanced mix of rote learning and a deeper understanding of the subject. The overall outcome of GP1 is comparable to that of the 2020 open book examination and to that of closed book exams in previous years. Whilst the mean mark was slightly lower than last year, both, the highest and the lowest overall mark were higher.

Questions:

1) Less than a quarter of the candidates attempted the question on phase transformations. It was the least popular question with the average mark being the third lowest of eight questions. The question consisted of two parts and progressed in difficulty. The Examiners considered this question to be a strong and fairly challenging open book question whereby the candidates needed to know the background of the Cu-Sn system and the ability to think through the problem.

2) The second question on phase transformation was more popular and attempted by 27 candidates. The style of the question was fairly traditional yet followed the open book style. The Examiners considered the question reasonably straightforward yet the average mark was the second lowest of the eight questions.

3) The first corrosion question was the most popular of eight questions, yet it had the lowest mean mark. Most of the candidates were on the right track, however, it appeared that the candidates did not read the questions carefully enough.

4) The second corrosion question had also a good combination of bookwork and problem-solving. Generally, the candidates made a good attempt of explaining how polarisation curves are obtained, but failed to address the finer details of the set-up, e.g., working electrode, counter electrode, reference electrode. The corrosion current is I_{corr} = 0.0119 A; the corrosion potential is E_{corr} = -0.31 V.

5) For the microstructure and polymers question the candidate needed to apply the concept of glass transition temperature to a real engineering problem which is covered extensively in the lectures. Most candidates recognised the scenarios required for brittle failure / permanent deformation / T_g of the ‘crosslinks’ well.

6) The highest mean mark was achieved for the powder processing question. Part a ii) appeared to be the more challenging aspect of the question. The time for an iron droplet to solidify is t_s = 0.065 s.

7) Surfaces and interfaces was the second most popular topic. Although the average mark was only the third highest, the lowest mark was the highest overall. The angle between the [111] and [001] directions can be calculated to be 54.7˚. For the {111} facets not to appear, the maximum ratio of $\sigma_{111}/\sigma_{001} = 1/\cos(54.7^\circ) = 1.73$.

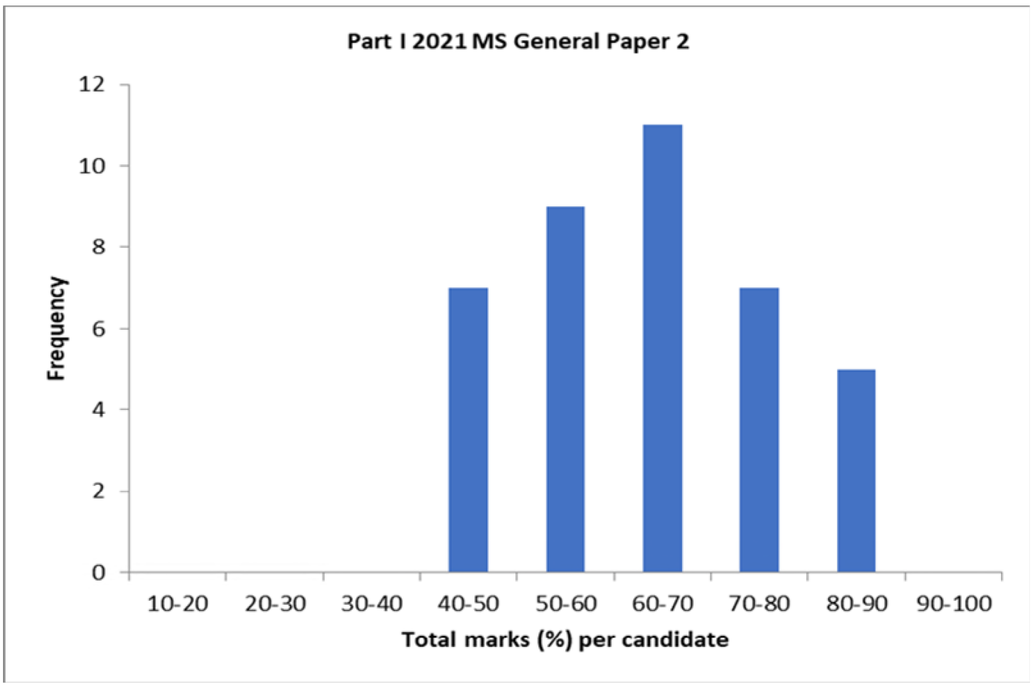
8) The question on ternary phase diagrams was fairly popular and the average mark was the second highest of the eight questions. The candidates were familiar with the style of part a) of the question as it was practiced in the tutorial sheet. It was the only question where full marks were achieved by some of the candidates.

General Paper 2 – Electronic Properties of Materials

Examiner: Professor Jason Smith
Candidates: 41
Mean mark: 63.77%
Maximum mark: 90%
Minimum mark: 41%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	15	12.20	19.5	2.5	Electronic structure
2	36	13.10	18.5	6	Electronic structure
3	40	11.28	17	3.5	Quantum & Statistical Mechanics
4	32	12.47	18	3.5	Quantum & Statistical Mechanics
5	33	10.59	17.5	5	Magnetic Properties
6	17	9.47	16	3	Tensor properties of Materials
7	9	8.78	14	1	Optical properties
8	21	12.19	18.5	1.5	Semiconductor materials



General Comments

This was a relatively low scoring paper with a raw average mark of 58.8% before scaling. Many candidates struggled to apply the theory they had learned to unfamiliar situations, on which there was rather more emphasis in the open book format. Many were also unable to complete five full questions within the three hours, which may have been a result of time spent looking things up during the exam. The distribution of marks was very broad as a result; a few candidates excelled, scoring over 80%, while several scored very poorly, in the 40-50% decile.

Questions:

1) An electronic structure question about densities of states in a 2D system, attempted by about a third of the candidates. Early parts of the question relating the Fermi energy to DoS with a single quantised level were generally done well. Part d on the 'staircase' 2D DoS was done poorly by almost all students, failing to understand how it relates to longitudinal and transverse motion and to work out how to find the Fermi energy where more than one quantised state was occupied. Some good answers were given however to the 3D limit in part e.
2) An electronic structure question requiring students to analyse the dispersion of the conduction and valence bands of a material. Attempted by nearly all students and generally done well, attracting the highest average mark on the paper. Parts a-d covering basics like turning points, band gap (including direct vs indirect) and effective mass were generally done well but with a few mistakes. Parts e and f involving analysis of indirect transitions and finding the minimum direct absorption provided a good differentiator between the stronger and weaker students.
3) A question on quantum mechanics focusing on quantum tunnelling and a finite square well wavefunction. The most popular question on the paper attempted by all but one student, but with a relatively low average mark. Most students showed a good knowledge of the concept of tunnelling and were able to give an example of a physical manifestation in their answer to part a. Part b(i) required students to 'show that' the ground state of the square well took the correct form, and students generally did this quite well although some missed out logical steps to get to the answer. Sketches of the wavefunction were often of an excited state. Most students knew the correct continuity conditions at the interfaces but some struggled to apply them, although many did so successfully despite the interfaces being away from the origin. Very few students were able to get far working out the probability of the particle being found in the barrier (part b(iii)), with many simply taking the modulus-square of the amplitude rather than integrating with respect to position
4) A statistical mechanics question attempted by about ¾ of the students and answered moderately well. Parts a-d covered the basics of microstates and macrostates, probabilities and Second Law- these were answered uniformly well. Parts e and f required a slightly better understanding of the statistics of two-level systems which tested some students. Most students knew that a population inversion was not a state of thermal equlilibrium but struggled to compare statistics of a large number of atoms with those of a small number. Part h was challenging, requiring students to be confident in the use of the partition function, Boltzmann probability and 'Shannon' entropy. Many students made no attempt at this despite the 5 marks of offer; a few made good progress but none got full marks.
5) A question on ferromagnetism answered by over ¾ of students but with a low average mark. Part a involved describing and manipulating the Curie-Weiss equations and was generally done well. Part b required students to problem-solve using the information provided and the majority of students struggled with this. In their answers to part c most students recognised that a ferromagnet becomes a paramagnet above T_C but failed to mention that domain formation upon cooling would require the sample to be re-magnetised.
6) A question on tensors answered by just under half of the students and with a low average mark. Part a concerned the need for a thermal expansivity tensor and its rank – this was generally answered correctly. Part b required students to set up a thermal expansivity tensor and use it to evaluate parameters in a rotated frame. About half were able to perform a simple rotation to find the zero-expansion direction, but very few were able to make sensible

estimates of tolerances and few were able to use the rotated tensor (depicted by many on a Mohr's circle diagram) to work out a shear displacement. Part c on wider considerations of quartz crystal orientation in a mobile phone elicited a range of ideas of varying relevance.

7) A question on optical properties of materials focusing on refractive index. The least popular question, answered by less than ¼ of students, and with the lowest average mark on the paper. Parts a and b were mostly bookwork describing firstly polarisation states of light and then birefringence and dichroism in anisotropic materials. These were mostly answered well. Part c asked students to derive Fresnel reflection and transmission coefficients at normal incidence using continuity of E and H. This was done poorly (or not at all) by most – several students started with the angle-dependent equations and worked backwards. The final part of the question required students to think about how an experiment could use transmitted and reflected light to measure birefringence and dichroism – there were a couple of good answers to this showing clear understanding.

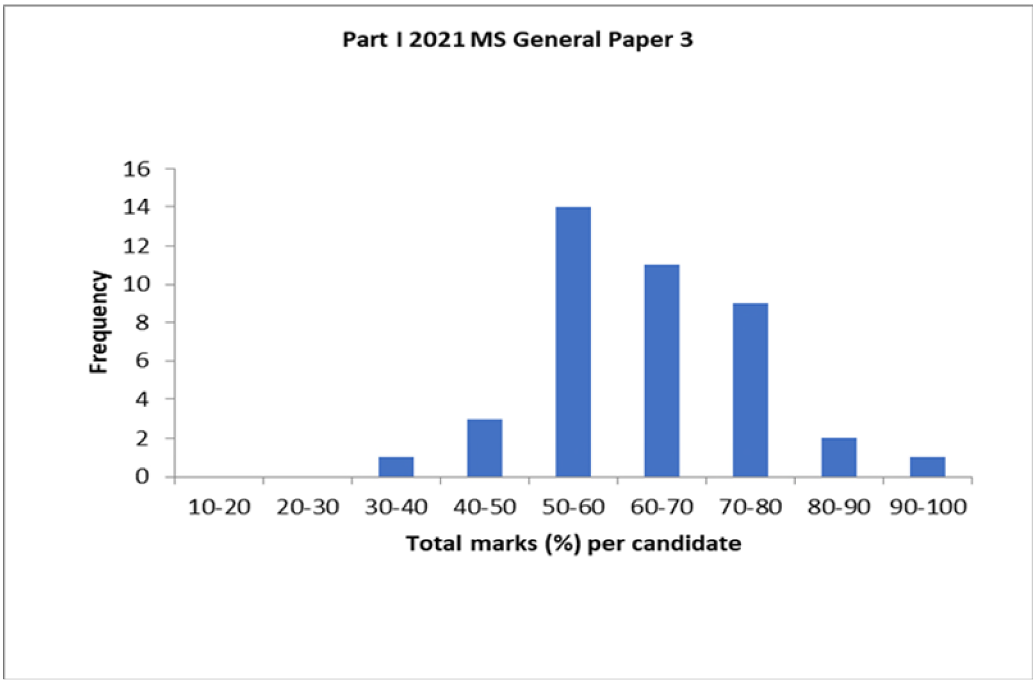
8) A question on semiconductors focusing on an asymmetric pn junction. Answered by half the students and with an average mark which was above average for the paper but nevertheless on the low side. Part a on carrier concentrations in doped materials was done well, and sketches of an asymmetrically doped pn junction in part b and calculation of the built in potential in part c were generally good even though the equation for the latter was not given in the paper. Parts d and e were generally done well by those who attempted them but many omitted them, possibly due to time constraints.

General Paper 3 – Mechanical Properties of Materials

Examiner: Professor Peter Nellist
Candidates: 41
Mean mark: 63.98%
Maximum mark: 91%
Minimum mark: 39%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	30	11.62	19	3.5	Elastic Deformation in Isotropic Materials
2	37	14.39	20	8	Microplasticity
3	4	10.50	11.5	9.5	Microplasticity
4	27	11.24	18.5	3	Fracture & Fatigue
5	39	11.26	18	3.5	Mechanical Properties of Polymers
6	17	8.82	13	3	Macroplasticity & Mechanical Working Processes
7	13	9.23	17	2	Creep
8	37	12.78	19.5	6.5	Composites



General Comments

The open book nature of this paper had increased the problem solving content compared to previous years. Questions that drew on concepts and ideas from outside the specific topic of the question posed more of a challenge to students. Descriptions and narrative answers were often somewhat brief and did not give a sufficiently explicit description. There were cases where some students had apparently run out of time, perhaps because of needing to spend time looking up information to answer the questions.

Questions:

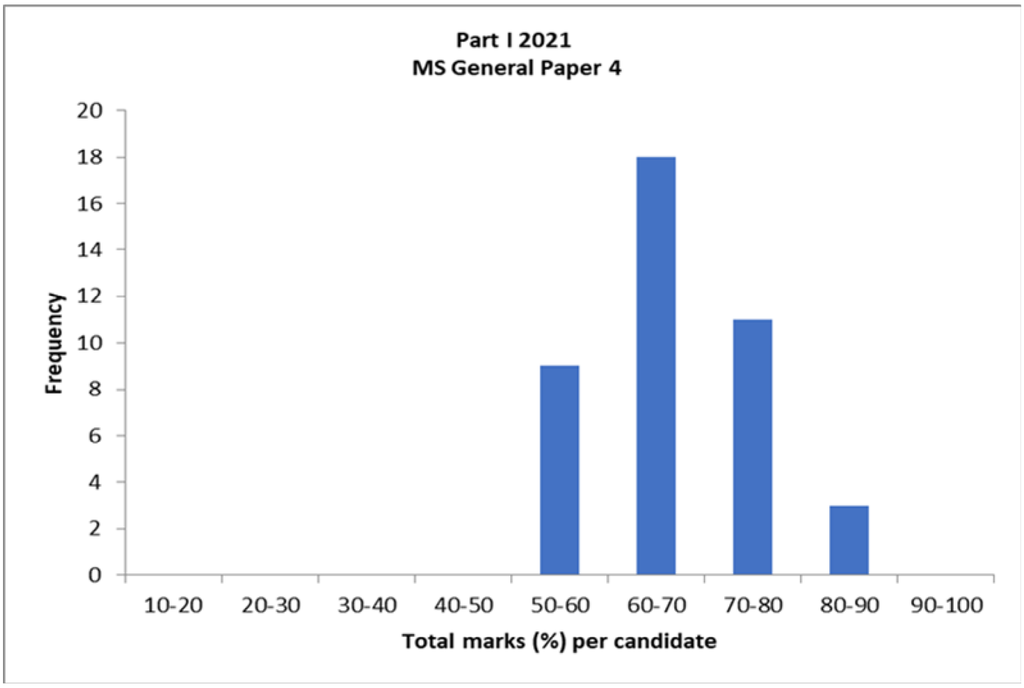
1) A popular question on the topic of isotropic elasticity. It was unusual compared to many in previous years by using a cylindrical coordinates problem that did not have full cylindrical symmetry. The answers to Part (a) generally showed a good understanding. Part (b) was unseen, and produced a wide range of marks. Many students reproduced a diagram that was not in the lecture notes and presumably found online, but the understanding shown was varied. Part (c) (i) was an unfamiliar derivation, but generally well tackled, and c(ii) familiar to most students. Part (c)(iii) was a challenging problem producing a wide range of marks, but some answers were excellent.
2) A very popular microplasticity question, with the first part of the question being familiar to most students. Some student did not explicitly show that the force was zero at the equilibrium points, and some students erroneously tried to find the zero of the differential of the force for the equilibrium point. Parts (e) and (f) were more synoptic and required a demonstration of good understanding. Marks ranged widely for these two sections
3) A very unpopular microplasticity question, potentially because of its rather open-ended style. The marks were rather narrowly spread, and not incommensurate with the rest of the paper. Candidates could generally identify the correct formula to apply to the situations encountered, but struggled to estimate appropriate values for some of the parameters required.
4) A popular question on fatigue. Part (a) was generally done well showing good use of the taught concepts. Many students were unable to make the required links across parts of the course to fully answer Part (b)(i). The calculations required for Part (b)(ii) were familiar to most students and accurately performed. Part (b)(iii) was found to be more challenging and required an understanding of a range of aspects of metallurgy to answer.
5) A very popular question on polymers. All parts of this question produced a wide spread of marks. In Parts (a) and (b), marks were frequently lost by not giving sufficiently complete or explicit answers. Part (c) produced some perfect solutions, but some students showed some confusion around the use of the friction term and its sign in the expression for shear yield stress.
6) This question on macroplasticity produced the lowest average mark of the paper, with none of the sections being strongly answered. The parts of this question requiring descriptive answers were often answered in a very brief way and missed some of the key details. A common error in the calculation in Part (b) is that students did not make use of the expression for mean pressure. In part (c), most students did not attempt to make use of the actual dimensions given in their answer.
7) This question on creep produced a relatively low average mark. Many of the errors made were rather basic, for example not realising that heating the sphere would lead to a pressure rise, or not making use of constant volume of the nickel during the creep process. In part (e), the stress exponent was often omitted when considering the time to failure. Students may have not been expecting to make use of non-creep concepts, such as the ideal gas law, in their answers to this question.
8) A popular question with a reasonable average mark. Part (a), (b) and (c)(i) were generally well answered. Part (c)(ii) required students to realise that the usual pull-out fracture energy formula could not be used for Composite A because the fibre does not fracture, which was missed by several students.

General Paper 4 – Engineering Applications of Materials

Examiner: **Professor Hazel Assender**
Candidates: **41**
Mean mark: **67.00%**
Maximum mark: **85%**
Minimum mark: **52%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	32	11.77	17	5	Engineering Applications of Polymers
2	18	9.56	14	4	Semiconductor Devices
3	25	11.32	16	6.5	Engineering Alloys
4	15	13.57	17	9	Engineering Alloys
5	28	14.86	19.5	8.5	Microstructural Characterisation
6	16	12.50	16.5	7	Microstructural Characterisation
7	35	13.07	19	8	Ceramics and glasses
8	36	11.83	16	6.5	Ceramics and glasses



General Comments

A paper with a good average mark and distribution of marks. There was a reasonable spread of attempts across the questions, although three questions, numbers 2, 4 & 6 were attempted by fewer than half of the candidates. There was some evidence to suggest that some candidates were searching the internet for answers rather than using their understanding of the lecture material and the information in the question to construct answers to the specific question posed. This may have resulted in too much time taken on this search, and the resulting answers contained rather generic information about the topic, rather than focussed answers to the question posed, resulting weaker marks.

Questions:

1) Engineering Applicationss of Polymers

   a) i) Often not enough explanation based on material – often a list properties
   ii) Many candidates described pressing of beads, which would be more suitable for a casting process.

   b) i) Most candidates mentioned conjugation, some delocalisation, and only a few made any comment on interchain conduction.
   ii) Some candidates suggested that the side group increased rigidity rather than giving more conformational entropy to increase solubility.

2) Semiconductor devices

   a) Candidates tended to say lots of relevant things, but were often not able to create a fully logical argument e.g. with correct causality of phenomena.

   b) Poorly answered – best answers relied on giving counter examples of where there would be gain.

   c) Many candidates considered EQE in terms of power ratio (the fill factor) rather than photons: electrons (current)

   d) Few candidates could do this section, despite the link to (a). The question did not ask for a different device.

   e) Candidates could gain marks for their reasoning e.g. *why* lattice mismatch a problem. Many wanted the band gap equal rather than lower and often did not consider mixed compositions or quantify the non-stoichiometric composition.

3) Engineering Alloys

   a) Generally well answered, though with more emphasis on mechanical properties than on chemical stability.

   b) Well answered.

   c) Candidates appeared to make heavy use of internet searching and this mean that answers were often not well structured/justified. Few candidates found reference to sulphur effect.

   d) Poorly answered. Many candidates put an emphasis on strength, rather than a specific consideration of fatigue crack growth rate. Surprisingly few candidates described the practical importance for turbine blades of this phenomenon, despite the obvious application route for this material.

e) Some candidates did not appear to address the different annealing temperatures at all. Some good answers, although often without fully defending why grain size was important for fatigue crack growth.

4) Engineering alloys

a) Generally well answered but candidates should give reasoned answers (e.g. why low density? Why is this important for this application?). Few referred explicitly to the applications given in the question.

b) Strong answers – could be heavily based on lecture notes.

c) Well answered.

d) Generally well answered – stronger if reasoned.

e) Most candidates could comment on the basal plane and lack of slip orientations, but fewer made a reasoned link between that and texture.

f) Often candidates failed make an explicit link between the stated lack of slip systems and microcracking. Quite a few were only able to give one modification.

5) Microstructural characterisation

a) i) A well-answered, straightforward section.
ii) Some candidates did not understand that the question only asked about the scanning technique. Some were able to state that the scan size on the sample was important, but did not explain why this led to a control of magnification.

b) i) There was a tendency for some candidates to put in sample requirements that are not requirements of the technique (although they may be useful for particular sample types, or for what contrast is desirable).
ii) Some candidates were weak on the ultimate resolution of the techniques.

6) Microstructural characterisation

a) Some candidates considered imaging rather than EDX effects, and others focussed on practicalities such as cost of equipment. Many candidates identified the main points around sample thickness, but often were not able to fully justify the implication e.g. thin sample, fewer X-rays produced….without saying why this matters.

b) i) Candidates found it difficult on the whole to mention/get correct all aspects for full marks. Sometimes explanations were missing of things drawn on a figure. Most were able to explain the origin and notation of the characteristic peaks, but correct description of the nature of the background signal was weaker.
ii) A few candidates appeared to miss this section altogether. Some did not make the distinction between ‘unresolved’ peaks and peaks that are not visible.

c) Numerical answer: 1.66:1 (or 5:3). Almost universally correct, but a very few candidates were unsure about mass and atomic fractions.

d) Quite a weak section, with a good number of candidates saying there would be no difference.

7) Ceramics and Glasses

a) A straightforward section, well answered.

b) Marks were lost when candidates stated differences but did not link either to why there is a difference for glasses, or why there is an advantage (e.g. 'there's less porosity' without saying why this is an advantage). There was often confusion about what leads to transparency in a material. Many candidates appeared to interpret 'glass' as 'glass ceramic'.

c) i) Reasons were sometimes scant and many candidates appeared to associate 'working temperature' with 'usable temperature'.
ii) Some answers were vague (e.g. 'additives')

d) i) Some good explanations, although often logical steps in the argument were not all made. Several candidates stated that the colour of glass was determined by the emission of photons rather than absorption.
ii) Many candidates were vague e.g. 'additives'

e) Not attempted by a number of candidates. Often the answer was put in terms of thermodynamics (which has a 'more favourable' crystal structure), rather than the kinetics of glass forming.

8) Ceramics and Glasses

a) Many candidates could write about the processes going on at different sintering stages, but found it difficult to link this to grain growth.

b) Most candidates could identify that formation of vacancies was important, but few could link to the dependency on the nature of the diffusing species with the vacancy type.

c) There was some confusion that 'hot pressing' meant a higher temperature than normal sintering. Some candidates could describe what happens in hot sintering without relating to removal of porosity.

d) A good proportion of candidates could do this question well. Numerical answer between 9 & 10 (depending on rounding errors).

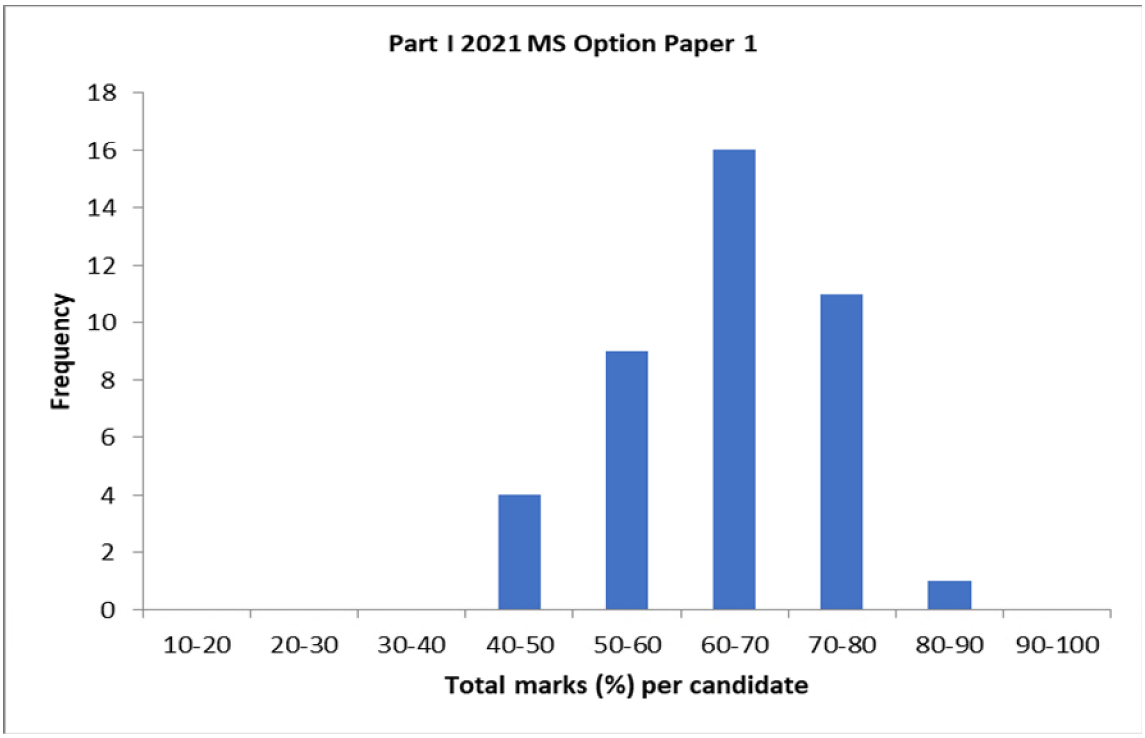
e) Most candidates could discuss something on the variation of stress in the sample, but this was sometimes not specific, and it was important to make the link between this and the effect on measured fracture strength.

Materials Options Paper 1

Examiner: Professor Richard Todd/
Candidates: 41
Mean mark: 64.15%
Maximum mark: 82%
Minimum mark: 41%

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	19	18.55	22	14	Advanced Manufacturing
2	17	14.76	22	9.5	Advanced Manufacturing
3	12	16.96	20	12	Nanomaterials
4	6	12.83	21	6	Nanomaterials
5	17	14.44	21	6	Materials and Devices
6	22	14.45	24	6	Materials and Devices
7	21	12.95	20	6	Prediction of Materials Properties
8	7	17.07	23.5	4	Prediction of Materials Properties
9	30	15.17	20	2.5	Engineering Ceramics
10	13	9.04	17.5	3	Engineering Ceramics



General Comments

The paper covered a very wide range of subjects but the average mark per question for each lecture course lay close to the mean for the paper. More detailed comments on the individual questions follow.

Questions:

1) The question concerned joining methods and an unseen problem concerning coatings. Considerable detail and the construction of rational arguments were required for high marks and many candidates were able to satisfy these requirements. The question had the highest average mark for the paper.
2) A question on casting of metal alloys. It began with a consideration of the casting of a particular component (part a). Most of this part was done well by many candidates but few realised why grey cast iron cannot be solidified rapidly, and not many described possible solutions to shrinkage porosity. Part (c) concerned constitutional undercooling in an unfamiliar setting (constant temperature gradient). Not many candidates engaged fully with the diagram requested but marks were nevertheless scored for more general knowledge.
3) Only 12 candidates attempted this question on carbon nanotubes (CNTs) but those who did tended to score high marks. Part (a)(i) concerned methods of filling CNTs. Many candidates answered this using a research review paper they had apparently found online (it was not included in the reading list for the lecture course). Some of these candidates had not fully understood the paper contents and lost marks commensurately. Other parts of the question were done well, including in some cases the "unseen" final part (d) concerning BN nanotubes.
4) A question on fabrication and scaling of field effect transistors which was only attempted by a few candidates. Most candidates struggled to construct convincing process flow diagrams in answer to section (a). Section (b) on high k dielectrics and the potential of 2D materials for FET devices was answered somewhat better with most students knowing the basic concepts. Section (c) was on nano-electromechanical sensors – most students knew about thermal noise limits and a couple were able to go further in discussing design parameters.
5) Question on waveguides which many candidates followed through to the end. Answers to (a) and (b) tended to rely on standard answers from lecture notes rather than being tailored precisely to the question. Part (c) considered a particular waveguide of rectangular cross-section. There were many reasonable attempts at this part. The most common problems were in determining the allowed modes for a waveguide with modes in two orthogonal dimensions, and which was the relevant dimension of the waveguide for different situations. Most candidates were prepared to attempt the "unseen" final part of the question, (d).
6) A question concerning solar cells on which a few candidates scored very high marks (highest mark = 24). There were many parts to the question for the students to negotiate and although some lost a few details as they progressed through the question, many followed it through to the end reasonably well.
7) A popular question on materials modelling using density functional theory but with a fairly low average score. Parts (a-c) required reading values off a graph and knowledge of the basics of the dynamical matrix for a simplified "two spring model", which most students completed well, the average mark for these sections being around 80%. Parts (d-e) considered comparison with a full DFT calculation and required more understanding of the physics and mathematics, while part (f) required the simplification of a dispersion expression for small wavevectors. These latter parts were generally done poorly or not at all, potentially due to time constraints.
8) This question on modelling the dielectric function in silicon was only attempted by a small number of candidates but attracted a high average mark. The question contained a small amount of bookwork but mostly concerned the application of taught theory to a previously unseen situation and associated calculations. Most students who attempted the question showed good familiarity with the basics and scored highly.

9) The most popular question, testing a range of knowledge regarding ceramic processing and sintering with a preamble in the style of research results that the candidates were asked to interpret. At least one candidate scored full marks on each part and there were some high total marks. Quite a few candidates answered questions based on their knowledge of oxide ceramics in general rather than using the evidence from the experimental results provided, as directed.

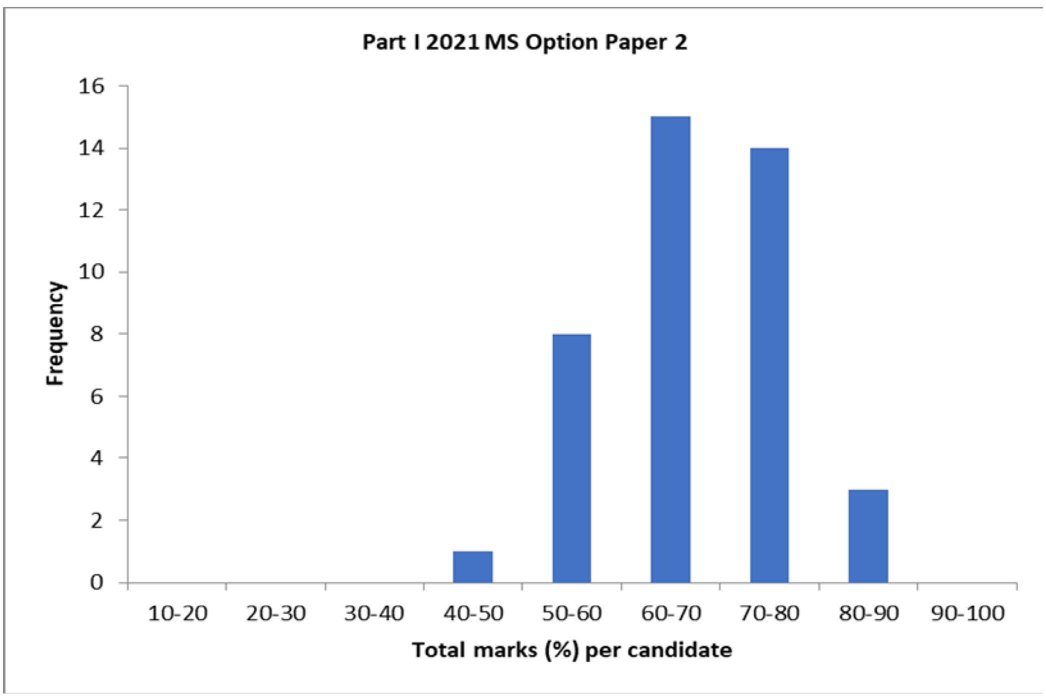
10) The question with the lowest average mark, attempted by 13 candidates. There was a substantial number of comments to the effect that the candidate had run out of time, so this may have been the “last choice” question in those cases. There were indeed several promising answers that ended abruptly before completion. Much of the question was “unseen” but it was based on standard concepts from the lecture course. Weaker attempts showed a lack of basic mathematical ability in the manipulation of logs and curve sketching.

Materials Options Paper 2

Examiner: **Professor Keyna O'Reilly**
Candidates: **41**
Mean mark: **67.39%**
Maximum mark: **87%**
Minimum mark: **47%**

Detailed comments on the paper are as follows:

Question	No of Answers	Average Mark	Highest Mark	Lowest Mark	Topic
1	19	16.11	23	4	Devices
2	5	11.50	15	8	Devices
3	11	16.14	20.5	12	Advanced Engineering
4	11	14.62	19	11.5	Advanced Engineering
5	9	13.83	17	8	Biomaterials
6	18	13.17	19	6	Biomaterials
7	29	17.00	22	9	Advanced Polymers
8	21	14.00	21	8.5	Advanced Polymers
9	26	18.29	22	10	Materials for Energy Production
10	15	14.60	20	7	Materials for Energy Production



General Comments

The scaled mark for this year's paper is similar to the mark (no scaling) for last year's paper and the spread of marks is also very similar. This year the questions were written as open-book questions, as opposed to last year where closed-book questions were modified to be suitable for open-book exams. There was less-than-expected evidence that candidates had directly copied out lecture notes or *Googled* for information on the internet. This may suggest that the candidates experienced time constraints.

Questions:

1) a) Well answered.

   b)

   i. Usually well answered. Some candidates did not connect the shape of the magnetisation curve in the mixed state to changes in the flux line lattice spacing.

   ii. Most candidates made most of the main points, but many only considered the first quarter of the hysteresis, and did not comment on J_c.

   c)

   i. Key to this question was understanding the geometry of the current loops. Many candidates did not appreciate that the current circulated throughout the volume, and hence did not integrate over *r* (or *h*). Several candidates incorrectly resorted to using Ampere's law to find the magnetic field from a current in a straight wire.

   ii. A number of candidates were not clear on how the value of M was taken from the graph, but most got the methodology correct. Numerical answer 300 A/m^2.

   iii. Generally well answered.

2) Few answers. Several had sections not completed which suggested a shortage of time to complete the answers. In general it was not the last question included in the submitted document which may suggest that this was not due to overall lack of time in the paper.

   a) Often poorly answered, with some candidates showing poor understanding of yttria-stabilised zirconia and the role of yttria for comparison.
   b) Most candidates considered the role of oxidation state and ion size, but tended to consider only substitution with Co, rather than Ti. Some good analysis of application.
   c) A poorly answered section where candidates did not pick up on the comparison with $BaTiO_3$.
   d) The stronger answers considered the doping effects of the substitution.
   e) Candidates were generally able to identify the application in fuel cells, but often did not consider the effect of aliovalent doping on oxygen vacancies. Cost was considered well.

3) a) Only a limited number of good answers. Most answers were too vague and lacked mention of specific applications/components and also the properties, including mechanical (specific) properties, physical properties, ease of manufacture, cost etc., which lead to a material being more or less suitable for that application.

b)

i. Only about half of the candidates correctly identified the class of alloy.

ii. Mainly good answers with the changes in microstructure as a function of position clearly described and the choice and discussion of suitable heat-treatments particularly well executed.

iii. This section required thinking beyond material directly covered in the lectures and had the poorest answers for this question. Candidates failed to make the correct correlations between the amount of primary alpha and the strength of the alloy, and of the grain boundary alpha and the ductility.

4) a) Largely bookwork and generally well answered.

b) Most candidates knew the main strengthening mechanism in conventional steels with martensitic structures, but not all gave sufficient explanation of how it arose.

c) Most candidates could correctly identify the four morphologies of martensite, and some could list factors which determine which microstructure is obtained, but few gave any explanation.

d) This was generally quite well done, but those candidates who related the crystallographic features to the strength of the material for all four morphologies did not gain additional credit over those who had only described the relationships for the two morphologies asked for in the question.

e) Most candidates could give some correct definition and description of the shape memory effect in martensite, but very few correctly described the different numbers of variants of the Bain strain involved in the forward and reverse transformations.

5) a) A poorly answered section. Many answers focussed on simple mechanical effects, and did not consider biological effects.

b) Some candidates were confused by the unit of microstrain. Another key challenge was to define the correct area over which the force is applied to define the stress. Candidates were able in general to outline the framework of the answer. Numerical solutions: i) 1.9 months, ii) 2.9 months, iii) 0.13 weeks.

c) Candidates often considered the correct factors, but sometimes got the conclusions wrong about which interface.

d)

i. Role and components generally good, but often weaker on specific role of the scaffold.

ii. Mostly well answered.

iii. Many candidates could identify the value of the materials in bone, but few considered both biological and mechanical considerations.

6) a) Most candidates could identify bone growth in response to load, but then the description was often quite vague.

b)

i. Open box case was identified more readily as triaxial, presumably as it appears isotropic.

ii. A good proportion of candidates could do the open cell case, but the closed cell case proved more of a challenge, in particular the relationship between modulus and l/t.

c) Often poorly answered, maybe due to confusion between cancellous and cortical bone.

d)

i. Many candidates could describe the micellar bilayer, but the reason for using two phospholipids was too often linked to the structure rather than control of properties.

ii. A good number of right answers, although some did not consider fractions of the mixture correctly, and did not appear to notice that this led to very peculiar values for the pure component breakdown temperatures. Numerical answer: 40%A, 60%B.

iii. Answers were often specific or specialised cases rather than “typical”.

iv. Many good responses.

7) a) Strong answers by many.

b) A range of attempts, but many candidates were only able to get partial marks e.g. for identifying the first few terms of the sequence. There was some confusion between chain ends and total number of monomers in the molecule.

c) Candidates needed to comment on why dendrimers do not entangle, and “change” in viscosity was not sufficient. Some sense of why there is a void or cavity in the dendrimer was needed for full marks.

d) Generally well answered but some vague statements made without clear justification or description e.g. “too expensive”.

e) The similarity seemed to present more of a difficulty than the difference.

f) Not sufficient to just comment on energy change. Some comment on materials interaction was needed.

g) Several candidates did not address the second aspect of the question.

h) Good descriptions of coherent and incoherent, but the more “unseen” aspect in terms of polymer identification proved a challenge for many.

8) a) Generally well answered, but some description was needed i.e. reproducing the figure from the lecture notes was not sufficient.

b) Most candidates did this simple calculation well, but they did need to recognise that the solvent was removed. The assumptions were often either unstated or weak. Numerical solution: 1.6 μm.

c) This section proved challenging. There were three aspects: what spinodal composition is – straightforward bookwork, usually done well; why it is particularly common in polymer-polymer mixtures – few addresses this directly; why it's likely for this particular system – a few candidates could comment on unfavourable enthalpy of mixing, high molecular weight or the similar volume fraction, but typically only one of these.

d) This section required the candidates to move on from thinking about polymer-polymer de-mixing to think about polymer-solvent mixtures. Some candidates calculated the solution concentration correctly (numerical answer about 8%) and some were able to consider the likely solubility (and why it is so low for polymer/solvent mixtures). More candidates considered the effect on viscosity for some credit.

e) Candidates were able, in the significant majority of cases, to give a very broad overview of the relationship (though typically did not consider the terms on each side explicitly), however candidates generally did not understand this equation as defining the initial stage of de-mixing only, and thus applied it for long timescales (coarsening). This also had implications for part (f).

f) The question was clear about the long timescale, so the equation for the initial wavelength was not relevant. This was a tough section which required good understanding of the case here: that de-mixing would be happening during the time in which the solvent was evaporating. As such, few candidates achieved good marks.

9)

a)

i. Well answered section.

ii. Although candidates generally stated that speed was the important factor, in some cases they did not say what the implication for this was on materials parameters.

iii. Several candidates did not state assumptions, as requested. There were frequent small mistakes in the calculation e.g. using the diameter not radius value, and in the conversion from rpm to angular velocity. Numerical answer: 3.2 MJ.

b) Well answered.

c) Many candidates gave a description of the two systems but did not focus on a comparison of them.

d)

i) Well answered section.

ii) Most candidates got the main points, but often were limited in the range of factors considered.

10) a) Most answers covered the main points, but lacked necessary detail. Fuel was generally correctly identified as enriched uranium oxide, but no detail on isotopes (and why) nor consideration of physical properties (e.g. thermal conductivity, high T_m and why needed), clad generally correctly identified as zirconium alloy but limited on properties other than neutron transparency and corrosion (e.g. thermal conductivity and why needed). Control of power through flow generally described, but lacking details on steam/water balance or comments on absorption as well as moderation. Descriptions of safety devices were very limited, with lack of detail on hydrogen as the explosive gas: many discussed containment systems. Descriptions of accident tolerant fuels were generally good, but many lacked sufficient discussion of the detrimental aspects.

b) A significant number of answers did not identify these as creep-resistant steels, with strengthening carbides that remain stable at high temperature. Explanations of the selection of alternative alloying elements (e.g. W to replace Mo) were limited (e.g. elements with similar properties due to position on periodic table).

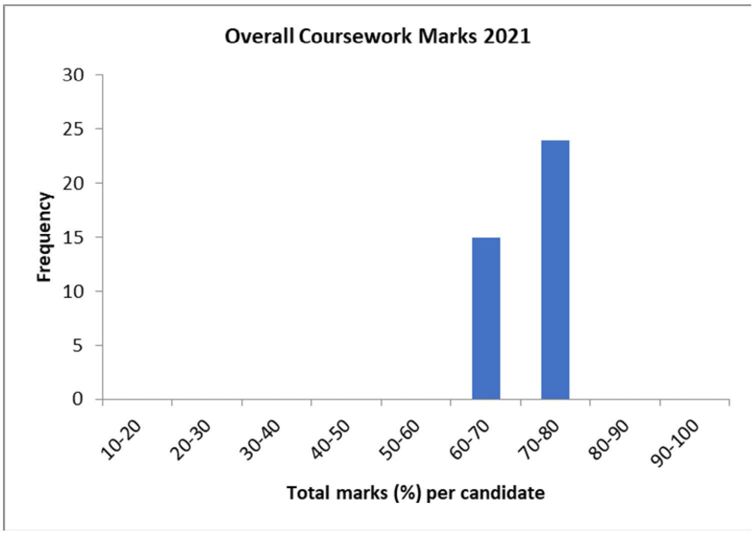
c) Broadly well answered, though many did not fully consider the relative contributions of construction, fuel production and decommissioning, nor likely lifetime.

COURSEWORK

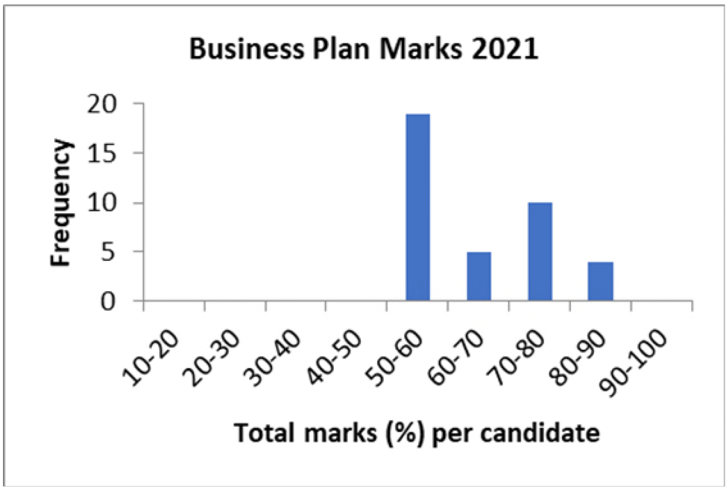
A maximum of 200 marks are available for Part I coursework which comprises:

- Y2 Entrepreneurship Module: Business Plan – 20 marks
- Y2 Industrial Visit Reports – 20 marks
- Y2 Practical Lab Reports – 60 marks
- Y3 Introduction to Modelling in Materials – 25 marks
- Y3 Option Modules: Advanced Characterisation/Atomistic Modelling– 25 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 63.24%) were in a relatively narrow range.



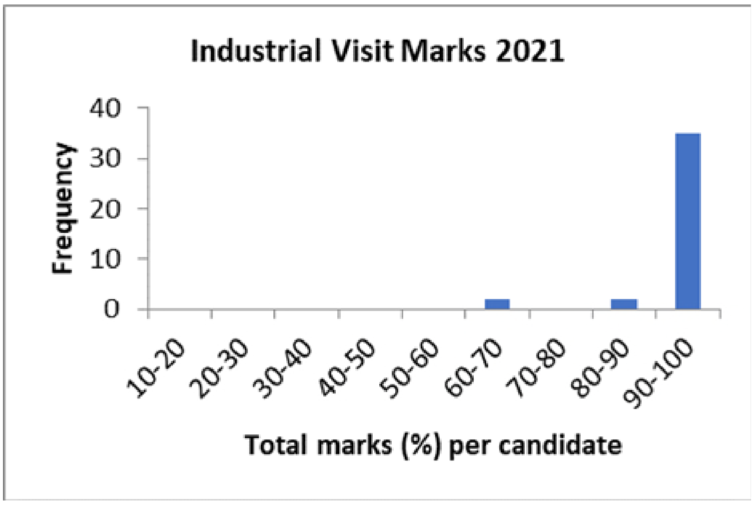
2020 Report on Business Plans (worth 20 marks)

The candidates for this module were arranged into 5 separate teams, with each team submitting a single business plan. The business plans were assessed by two examiners according to the marking scheme published in the course handbook, and were subsequently moderated. Each member of team was awarded the same mark on the basis of the teams' work. The assessment criteria are based on 8 different sections of the business plan which are weighted according to their importance for the plan.

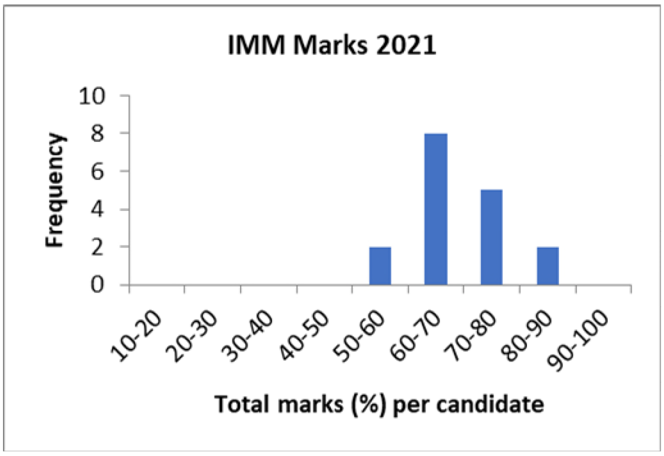
In 19/20 the most highly marked plans were more consistent across the different sections, with each reinforcing and interrelating to each other resulting in a high overall score. Overall the product sections were weaker than normal with teams not outlining or articulating the benefits of their products clearly. The plans with lower marks show some significantly weaker sections. This is compounded when those sections were either or both the commercialisation issues and risk assessment sections, which combined make up 40% of the marks. Most teams this year could have developed their commercialisation issues more strongly. Working as a team they should be able to help one another identify issues and collectively be able to develop responses to them. These two sections should clearly draw out the weakness of the ideas as a whole, and suggest appropriate mitigations. If not enough time is given to consider these, or the team is not working together to reflect how the different sections interrelate and combine, then it is likely these sections are weaker. A strong business plan, which would receive high marks should have strong rationale and arguments in all of the sections which combined make a compelling case (and accordingly high mark).

Dr Stuart Wilkinson
Entrepreneurship Convenor 2019/20

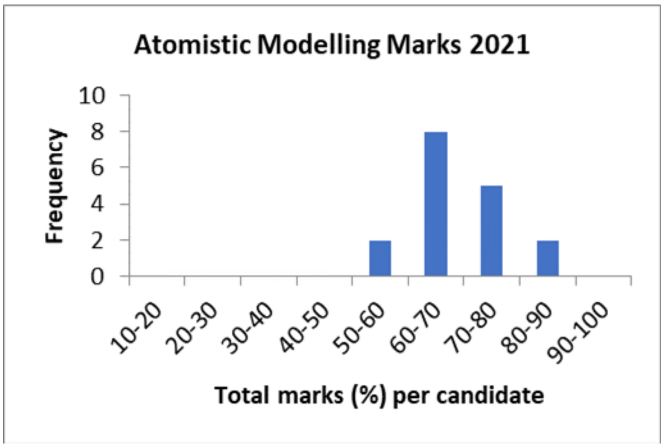
The **Industrial Visits** mark (average 97.3%) are near-perfect, as full marks can be obtained by producing a good report; the small number of reports that are only satisfactory or late are strongly penalised. Due to the COVID-19 pandemic, candidates were allowed to submit 3 instead of the original 4 reports. A weighting factor was applied to ensure that the assessment marks were still based on a maximum of 20 marks.

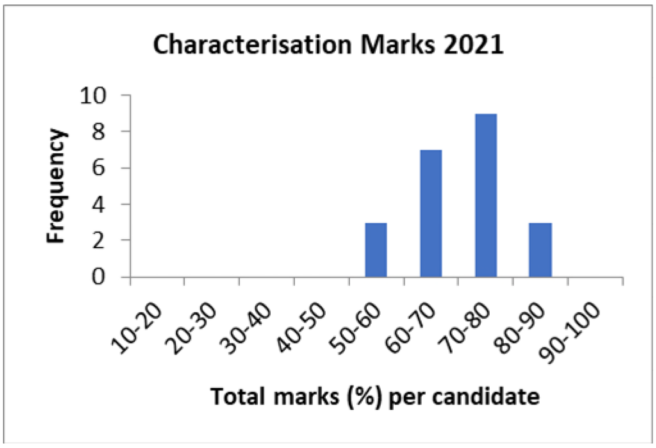


Marks for the compulsory **Introduction to Modelling in Materials** module (average 64.74%) ranged throughout the lower 2nd to 1st class boundaries.



The option modules, **Atomistic Modelling** (average 68.12%) and **Advanced Characterisation** (average 69.36%), exhibit a full range from lower 2nd class to good 1st class marks. The work done was reviewed independently by the Examiners.





Report on the Introduction to Modelling for Materials Science module
This was the first year the IMM course has run for the whole cohort of students. The practical elements of the course were completely rewritten this year. In addition Prof Ed Tarleton took over responsibility for the final day's lecture, class and associated project on finite element modelling. Due to the pandemic the course was run entirely remotely. Morning lectures were recorded. Afternoon classes were run remotely with a large online class.

Days 1-4 were run using 4 remote severs in the MML. Students connected using a web-browser to run Jupyter notebooks (python based). This built on the coding experience the students had from the 1st year Computing for Materials Science Course. The final day was run using Matlab.

In the second week students completed 2 projects from a choice of 4 - one project for each of day 2-5 topics was available. Support for the projects was provided via a dedicated email. The senior demonstrator (JRY) monitored this, and forwarded questions to other demonstrators when appropriate.

Project 1 (DFT) was done by almost all students. Project 2 (MD) and 3 (Calphad) where fairly evenly split, and Project 4 was only taken by a small number of students - however, those who attempted this project scored highly. The projects were generally of a good standard, but many students could have improved the presentation of the reports, particularly the quality of graphs.

Prof. J.R Yates
Trinity 2021

Report on Atomistic Modelling Option Module

(i) Availability of software/hardware
Each student was given a user account on one of three multi-core Linux servers based in the Department. The students were instructed how to install and use freely available software (e.g. MobaXterm) to access these servers from the various operating systems installed on their own personal computers. The modelling calculations were performed using CASTEP, with additional postprocessing and analysis performed using the OptaDOS and SUMO packages. All of these packages were pre-installed on the servers and the students instructed how to run software serially and in parallel. The lecturers provided technical support and troubleshooting through emails and MS Teams calls, and there were no serious technical issues which could not be quickly resolved.

(ii) Other pertinent information
The option was conducted entirely remotely, with pre-recorded lectures, live question and answer sessions via Teams and self-paced practical sessions with the lecturers available through Teams and email.

Dr C.E. Patrick
2020-21

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

However, COVID-19 restrictions in place in Hilary Term of 2021 meant that the hands-on experimental aspect fundamental to this course was not possible, thus requiring significant modifications to the manner in which the course was operated.

Hence this year, upon selecting a material system of interest (from a provided list of candidate materials), students were provided with a range relevant data pertaining to a sample of this materials as characterised using techniques such as optical microscopy, SEM, EDX, AFM, hardness testing etc. Data was distributed to the students one technique at a time on request at intervals of at least 24 hours. This was designed to encourage students to focus attention on each type of characterisation dataset and emulate the time take to generate new data, and the process of using this data to inform the selection of the subsequent technique.

The students were tasked with sifting through the significant amount of data and applying further analyses to identify a key set of complementary microstructure characterisation results that would tell a novel account of some aspect of that sample(s). Students were also urged to draw on the literature to interpret their received experimental results, and to place their findings in context of existing research in the relevant area.

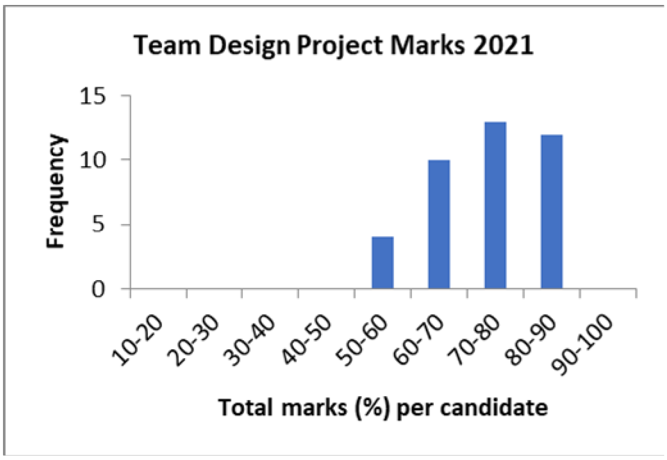
Overall students did a good job under challenging circumstances. In particular, students engaged well with the course, particularly with the Literature Review Discussion Groups, which was a new element added this year and will most likely be retained for next year. Although, some high quality reports were received, on the whole, the narratives that students developed from the available data could be described as more narrow, or 'safer', than previous years. There was a tendency to interpret the data around more general, pre-conceived and well established microstructural phenomenon that students were familiar with from previous courses, rather than to explore some of the more novel microstructural features that arose within the data.

However, this is almost certainly due to a disconnect with data, given that the students did not generate it themselves. In particular, students had to work with the data that was available, rather than being able to direct the focus of their own subsequent experiments upon the basis of further investigating some interesting aspect identified within a previous characterisation. This undoubtedly restricted creativity, and was taken into account.

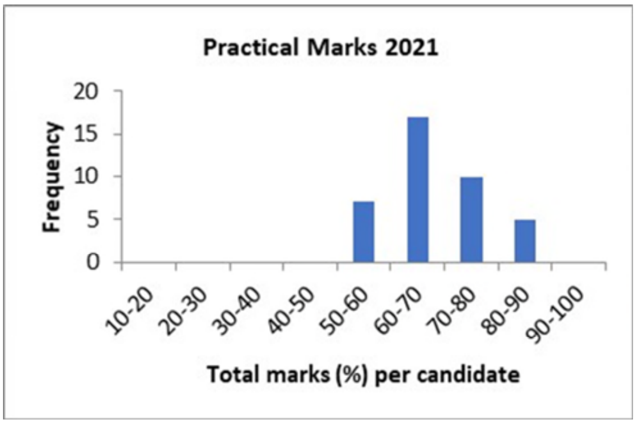
The average mark this year was 69.4. We look forward to getting back into the lab to run the course as intended in 2022. However, the students should be commended for making best of a challenging situation.

Prof M.P. Moody
Trinity 2021

The **Team Design Project** marks (average 70.03%) show a moderate narrow range, close to the upper second/first class level, which is reasonable given the sustained effort in a group task.



The marks for **Practical Classes** (average 67.9%) have been reviewed by the Practical Class Organiser, who concluded that, although the range of marks for an individual practical varied from practical to practical, all students have been treated equally.



Report from the Practical Classes Organiser
Materials Science 2nd year Practical Labs in 2019/20

I have reviewed the marks from the 2nd year Practicals from 2019-20. There is quite a wide range of overall average marks, assuming the standard penalties are applied, ranging from 54 to 84%, with an average and median of 67%. These general results are in line with past years records. The range of marks for an individual practical vary from practical to practical. They were all within 20% of each other.

Gender: I have assessed the marks for gender imbalance by looking to see who has received the highest and lowest marks for each practical. While last year, female students exhibited 20% higher marks than their male counterparts on average, this year their marks are similar within 1%.

Penalties: I have looked at the suggested penalties and am recommending that these are accepted in their entirety. Medical certificates were supplied by some students to cover late submission and penalties waived accordingly in line with the guidance in the course handbook. There are some cases deserving further comments:

-Some candidates submitted their reports shortly after the deadline (up to 15min late). I suggest the penalty is waived since it is likely it is the consequence of a technical delay and they would have not gained any additional academic advantage. This is the case for one student in 2P1, one in 2P6 and one in 2P12.

Special cases:

- Due to COVID-19, please note that Trinity term practicals 2P11 Mech Props of Polymers, 2P8 TEM, 2P4 XRD and 2P5 SEM & Fracture were cancelled with no marks awarded. Average marks have been calculated taking this into account.
[redacted]
- There are a number of students who were late submitting but were able to present either medical certificates explaining the reasons for the delay. No penalties are to be awarded in these circumstances, in line with the rules outlined in the handbook.

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

Practical Class Organiser – Sergio Lozano-Perez
June 2021

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 (%)		
	2020/21	2019/20	2018/19	2020/21	2019/20	2018/19
I	19	19	11	65.5	57.6	34.4
II.I	9	12	17	31.0	36.4	53.1
II.II	1	2	2	3.4	6.0	6.0
III	-	-	1	0	0	3.0
Pass	-	-	0	0	0	0
Fail	-	-	1	0	0	3.0
Total	29	33	32	-	-	-

(2) **The use of vivas**
The same procedures for the use of vivas were employed as per in 2020. 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 vivas was led by the Internal Examiners or Assessor who had read the thesis fully, and one of the External Examiners also had the opportunity to ask questions.

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

B. NEW EXAMINING METHODS AND PROCEDURES

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

The parallel streams, record keeping, Assessors to keep the Examiners workload from exceeding ~8 theses, and indeed the MS Teams mechanism for vivas, are appropriate for adoption in an on-going model.

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

There were a number of theses whereby the Examiners Examiner + Assessor who had read the thesis in full differed significantly in the mark awarded. This tended to be when particular aspects of the thesis were done well, whilst others were done rather more poorly. It would be helpful for Faculty to review the “MS Part II Project Marking Guidelines” in an attempt to make it easier for the Examiners’ marks to converge more easily.

D. EXAMINATION CONVENTIONS

The current year’s Conventions (adapted to reflect the changes due to the COVID-19 pandemic) were put on the Departmental website and sent electronically to all candidates. The Examination Conventions were assessed by the Board of Examiners and the Department’s Academic Committee.

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

Of the 29 candidates whose results were ratified by the examiners all 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 30 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. The marks for the Part II examination ranged from 60% to 81% with an overall mean mark just below the 2:1/1st class boundary. 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 her thanks to both of them for their hard work in inspecting the substantial number of Part II theses and contributing to the vivas.

Four Assessors were appointed in addition to the six examiners. This was one more Assessor than last year, despite there being slightly fewer candidates this year compared to last (29 versus 33). This however helped to alleviate the time constraints imposed on Examiners and Assessors due to eight candidates being granted extensions to their projects by the Proctors. In five of these cases the maximum extension possible was granted i.e. noon on the day before the marks were due to be submitted by the Examiners/Assessor to the Administrative team.

One candidate was awarded a longer extension and will be examined by the 20-21 examining board in the 2021-22 academic year.

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 (although a Form 2D alerting the examiners to an SpLD of some sort was included where appropriate).

	Overall mark (allowing for 'safety net')		Part II Project		Part I Mark	
mark (%)	Male	Female	Male	Female	Male	Female
30-40	-	-	-	-	-	-
40–50	-	-	-	-	-	-
50–60	2	-	-	-	2	-
60–70	7	4	13	6	6	5
70–80	8	8	4	5	8	6
80–90	-	-	-	1	1	1
90-100	-	-	-	-	-	-
Totals	17	12	17	12	17	12

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 (2020) 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

Mitigating Circumstance: Notices to Examiners.

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

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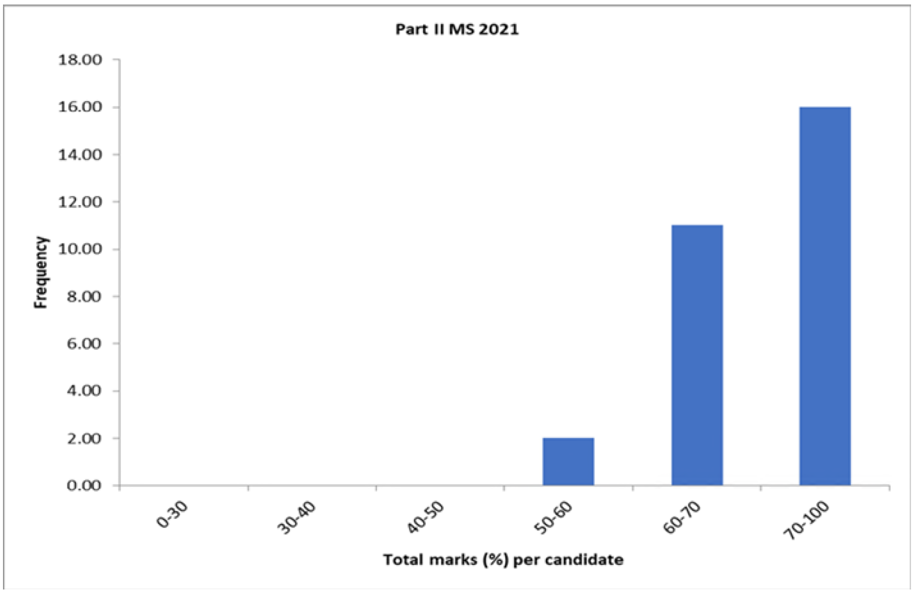
F. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

Prof. H.E. Assender	Prof. K.A.Q. O'Reilly (Chair)
Prof. N. Grobert	Prof. P.D. Nellist
Prof. J.M. Smith	Prof. R.I. Todd
Prof. G. Williams (external)	Prof. P.D. Haynes (external)

Report on Part II Projects

Candidates: **29**
Mean mark: **69.17%**
Maximum mark: **81%**
Minimum mark: **61%**

Detailed comments on the paper are as follows:



General Comments

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

Obviously 2021 was an extraordinary year for both students and staff, and for the Part II cohort this was acutely obvious. The timetable for Part II was modified in order to accommodate the University's requirements that Part I Finals be postponed until Michaelmas Term of the 4th year. The students started their Part II projects in the second half of Trinity Term of their third year, and used this time to work on their Literature Reviews. The usual extended term dates applied, but the first part of Michaelmas Term was devoted to revision and Part I Finals. The projects re-commenced in fourth week of Michaelmas Term. Students had access to laboratories but this access was limited by covid-19 regulations. Training on equipment was particularly difficult/delayed in many cases. Even students who undertook more theorical/modelling orientated projects typically suffered impacts, as computer systems where less reliably maintained and moreover access to the expert advice of supervisors and group members was more constrained. Obviously, full account of these difficulties was taken into account by the Examiners and Assessors.

As per last year, the students were asked to submit, as part of their thesis but outside of the core word count constraint, a 'Reflective Account' describing the impact of the covid-19 pandemic on the progress of their project. This was invaluable for the markers but moreover the authoring of this section evidently offered some catharsis for the students as they struggled to maximise the coherence of their disrupted projects.

Examination Conventions 2020/21
Materials Science - Final Honours School
(revisions reflecting the changes introduced for COVID-19 pandemic)

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 2020-21; the entries in green font reflect the special measures and changes adopted to allow for the COVID-19 pandemic. The Department of Materials' Academic Committee (DMAC) is responsible for approving the Conventions and considers these annually, in consultation with the examiners. The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. These Conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. Normally the relevant Regulations and MS FHS Handbook are the editions published in the year in which the candidate embarked on the FHS programme. The Examination Regulations may be found at: 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 and Options Paper 1 and 2 in Trinity Term 2021 will be sat as open-book exams via the online assessment platform. The mode of completion of each of these papers will be fully handwritten answers which will need to be scanned and uploaded. (It is possible to apply for an alternative mode on the grounds of disability or medical condition as an exam adjustment.) For these online exams, there will be a technical time allowance of 30 minutes per exam for upload and technical difficulties.

The structure, content and duration of the online open-book examination papers has been reviewed carefully by the examining board of internal and external examiners. In the main, the Part I examination questions that are used for revision purposes are already designed to assess understanding, rather than memory-recall of facts. This means that only some minor changes to the traditional 'closed-book' papers have been necessary to make them suitable to be sat as open-book.

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

[1] for the 2020-21 examinations the Nominating Committee comprised Prof Nellist, Prof Marrow & Dr Taylor.

question, and stronger candidates can show the depth of their understanding in answering other parts. The wording and content of all examination questions set, and the suggested exemplar answer and marking schemes, are scrutinised by all examiners, including the external examiners. The marking schemes are approved by the examining board alongside the papers.

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

Examiners proof read the final 'camera-ready' pdf version of each examination paper. Great care is taken to minimise the occurrence of errors or ambiguities. Despite this care, on occasion an error does remain in a paper presented to candidates: if a candidate thinks there is an error or mistake in the paper, then they must state what they believe the error to be at the start of their answer to that question and if necessary, state their understanding of the question. The examiners will then consider the validity of the error and assess the impact of the error on candidates' choice of questions and on the answers written by those who attempted a question that contained an error, and will take this impact into account when marking the paper.

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.

3. MARKING CONVENTIONS

3.1 University scale for standardised expression of agreed final marks

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

3.2 Qualitative criteria for different types of assessment

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

70-100	The candidate shows excellent problem-solving skills and excellent knowledge of the material over a wide range of topics, and is able to use that knowledge innovatively and/or in unfamiliar contexts. The higher the mark in this band the greater will be the extent to which these criteria will be fulfilled; for marks in the 90-100 range there will be no more than a very small fraction, circa 5-10%, of the piece of work being examined that does not fully meet all of the criteria that are applicable to the type of work under consideration. The 'piece of work' might be, for example, an individual practical report, a question on a written paper, or a whole written paper.
60-69	The candidate shows good or very good problem-solving skills, and good or very good knowledge of much of the material over a wide range of topics.
50-59	The candidate shows basic problem-solving skills and adequate knowledge of most of the material.
40-49	The candidate shows reasonable understanding of at least part of the basic material and some problem solving skills. Although there may be a few good answers, the majority of answers will contain errors in calculations and/or show incomplete understanding of the topics.
30-39	The candidate shows some limited grasp of basic material over a restricted range of topics, but with large gaps in understanding. There need not be any good quality answers, but there will be indications of some competence.

0-29	The candidate shows inadequate grasp of the basic material. The work is likely to show major misunderstanding and confusion, and/or inaccurate calculations; the answers to most of the questions attempted are likely to be fragmentary.

3.3 Verification and reconciliation of marks

Part I Written Papers

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

All scripts are double marked, blind, by the setter and the checker each awarding an integer mark for each question. After individual marking the two examiners meet to agree marks question by question. If the differences in marks are small (~10% of the maximum available for the question, 2-3 marks for most questions), the two marks are averaged, with no rounding applied.

Otherwise the examiners identify the discrepancy and read the answer again, either in whole or in part, to reconcile the differences. If after this process the examiners still cannot agree, they seek the help of the Chair, or another examiner as appropriate, to adjudicate. An integer total mark for each paper is awarded, where necessary rounding up to achieve this.

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

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*

Three 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 three 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 Canvas.

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

(4) *Team Design Project*

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

(5) *Introduction to Modelling in Materials*

The two reports for this module are double marked, blind, by the module assessors. Normally, at least one of the two assessors for each report will be a module organiser. The assessors then compare marks and analyse any significant disagreement between these marks before arriving at a final agreed mark for each report. The lead organiser for the Introduction to Modelling in Materials Module submits to the Assessors and Examiners of the module a short report which provides (i) a summary of the availability of the software & hardware required for each mini-project and (ii) any other pertinent information. The reports for the Introduction to Modelling in Materials module are allocated a maximum of 25 marks (each report allocated a maximum of 12.5 marks). Guidance on the requirements for the reports and an outline marking scheme are published on Canvas.

(6) *Advanced Characterisation of Materials and Atomistic Modelling Modules*

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

Part II Coursework

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

The Supervisor's report is divided into Parts A & B: Part A provides simple factual information that is of significance to the examiners, such as availability of equipment and the impact on the **project** of the COVID-19 pandemic, and is seen by the two markers before they read and assess the thesis. Part A does **not** include personal mitigating circumstances which, subject to guidance from the Proctors, normally are considered only in discussion with **all** Part II examiners thus ensuring equitable treatment of all candidates with mitigating circumstances. Part B of the supervisor's report provides her/his opinion of the candidate's engagement with the project and covers matters such as initiative and independence; it is not seen by the examiners until the discussion held after the viva.

The project is allocated a maximum of 400 marks, which is one third of the maximum available marks for Parts I and II combined. Two Part II examiners read the thesis (including the final chapter with the reflective accounts of project management, health, safety & risk assessment processes, and ethical and sustainability considerations), together with Part A of the supervisor's report, and each of them independently allocates a provisional mark based on the guidelines***** published in the course handbook. In addition, normally the thesis will be seen by one of the two external examiners.

A *viva voce* examination is held using video-conferencing technology: the purpose of the viva is to clarify any points the readers believe should be explored, and to ascertain the extent to which the work reported is the candidate's. Any examiners who have supervised the candidate's Part II project or are their college tutor will not be present at the viva or the subsequent discussion. Normally four individuals will have specified examining roles: Two examiners, or one examiner and an assessor, who have read the thesis entirely; the external examiner to whom the thesis was assigned; and an examiner acting as the session Chair who will complete any necessary documentation for that viva. Other examiners beyond these four individuals will be present to the extent possible given the existence of parallel sessions. A discussion involving all examiners present is held after the viva, during which Part B of the supervisor's report and the impact of COVID-19 on the project is taken into account. The outcome of the discussion is an agreed mark for the project. In arriving at the agreed mark the Examiners will take into account all of the following, (i) the comments and provisional marks of the original markers, (ii) the candidate's understanding of their work as demonstrated during the viva and (iii) the opinion of the external examiner who has seen the thesis.

If the two provisional marks allocated in advance of the viva differ significantly (that is, normally by more than 10% of the maximum available for a Part II project) this will be addressed explicitly during the discussion after the viva. In the majority of other cases the viva has only a small influence on the agreed mark awarded to a Part II thesis.

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

3.4 Scaling

Part I Written Papers

As the total number of candidates is small, it is not unusual for mean marks to vary from paper to paper, or year to year. It is not therefore normal practice to adjust marks to fit any particular distribution. However, where marks for papers are unusually high or low, the examiners may, having reviewed the difficulty of the paper set or other circumstances, including any relating to open book exams, 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. (See asterisked note under Section 3.5)

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 a cover page which questions, up to the prescribed number, they are submitting for marking. If this information is not provided then the examiners will mark the questions in numerical order by question number. If the candidate lists more than the prescribed number of questions then questions will be marked in the order listed until the prescribed number has been reached. The examiners will NOT mark questions in excess of the prescribed number. If fewer questions than the prescribed number are attempted, (i) each missing attempt will be assigned a mark of zero, (ii) for those questions that are attempted **no** marks beyond the maximum per question indicated under section 2 above will be awarded and (iii) the mark for the paper will still be calculated out of 100. In addition, for the Materials Options Papers, as per the rubric, the examiners will mark questions from only three sections. Should a candidate attempt questions from more than three sections the examiners will mark those questions from the first three sections in the order listed by the candidate on the covering page. If this information is not provided then the examiners will mark the sections in alphabetical order by section delineator (section A, section B, etc.).

Part I Coursework

It is a requirement for candidates to submit an element of coursework for each of the following: Practical Classes; Industrial Visits; Engineering & Society Coursework (or substitution); Team Design Project; Introduction to Modelling in Materials, Advanced Characterisation of Materials or Atomistic Modelling. For the Practical Classes and Industrial Visits, the element of coursework comprises a set of reports: reports on three Industrial Visits* and reports on eight 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.

* The total number required has been adjusted to allow for the COVID-19 pandemic; the summed marks for these elements will be scaled proportionately so that the maximum achievable number of marks remains the same.

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 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. A Team Design Project Report and associated oral presentation; 4. A set of three Industrial Visit Reports as specified in the course handbook; 5. A report on the work carried out in the Introduction to Modelling in Materials module; 6. A report on the work carried out in either the Characterisation of Materials module or the Atomistic Modelling module; and 7. A Part II Thesis). Rules governing late submission of these seven elements of coursework and any consequent penalties are set out in the 'Late submission and non-submission of a thesis or other written exercise' clause of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations (Part 14, 'Late Submission, Non-submission, Non-appearance and Withdrawal from Examinations' in the 2020/21 Regulations). A candidate who fails to submit an element of coursework by a prescribed date and time will be notified of this by means of an email sent on behalf of the Chair of Examiners.

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

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

(b) Under para 14.9. In the case of submission on or after the prescribed date for the submission and within 14 calendar days of notification of non-submission and without prior permission from the Proctors: subject to leave from the Proctors to impose an academic penalty, for the first day or part of the first day that the work is late a penalty of a reduction in the mark for the coursework in question of up to 10% of the maximum mark available for the piece of work and for each subsequent day or part of a day that the work is late a further penalty of up to 5% of the maximum mark available for the piece of work; the exact penalty to be set by the Examiners with due consideration given to the circumstances as advised by the Proctors. The reduction may not take the mark below 40%.

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

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

It should be noted that the maximum extension that the examiners can accommodate for a Part II thesis to be examined in the 2020/21 session is 14 days. Any extension awarded for longer shall mean the assessment will be considered by the scheduled examination board in the next academic year.

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

Penalties for late submission of individual practical reports are set out in the 2019/20 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 2019/20 version) and are **separate** to the provisions described above. In short normally this will be deemed to be a failure to complete satisfactorily the relevant element of Materials Coursework and will therefore constitute failure of Part I of the Second Public Examination.

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

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

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

3.8 Penalties for poor academic practice

Substantial guidance is available to candidates on what constitutes plagiarism and how to avoid committing plagiarism (see Appendix B of the 2019/20 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 and a warning letter to be issued to the candidate explaining the offence and that the present incident will be taken into account should there be a further incidence of plagiarism. For a student who remains on course in addition there will be a requirement to demonstrate to their college Materials Tutorial Fellow that in the period between the present offence and the next submission of work for summative assessment they have followed to completion the University's on-line course on plagiarism (https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism?wssl=1).

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

Honour code for open-book and closed-book remotely invigilated online exams

"The University's honour code interacts with and must be read and understood in conjunction with other regulations and policies including:

- the University's disciplinary regulations concerning conduct in examinations;
- the University Student Handbook, in particular sections 9 and 10; and
- the Education Committee's information and guidance on academic good practice and plagiarism.

The University views cheating, acting dishonestly and/or collusion in an examination as a serious disciplinary offence that may result in disciplinary actions, with the most severe penalty being expulsion from the University without a qualification. In the context of open-book and closed-book remotely invigilated examinations:

- the University considers that accessing the question paper via any other means than directly, via the designated online platform, and/or sharing the question paper with other students, falls within its definition of cheating and of acting dishonestly.
- the University reserves the right to use software applications, such as TurnitIn, to screen submitted work for matches either to electronic sources or to other submitted work.

Expected Standards of Behaviour

Students are expected to act as responsible members of the University's community.

In the context of open-book examination, this means students are permitted to:

- refer to their own course and revision notes; and
- access offline or online resources, for example textbooks or online journals.

In the context of closed-book remotely invigilated examinations, this means that students are not permitted to refer to any materials beyond those provided as part of the exam paper or that are expressly permitted for that exam.

In both open-book examinations and closed-book remotely invigilated examinations, this means that students are expected to:

- submit work which has not been submitted, either partially or in full, either for their current Honour School or qualification, or for another Honour School or qualification of this University (except where the Special Regulations for the subject permit this), or for a qualification at any other institution; and
- indicate clearly the presence of all material they have quoted from other sources, including any diagrams, charts, tables or graphs. Students are not expected to reference, however if you provide a direct quote, or copy a diagram or chart, you are expected to make some mention of the source material as you would in a typical invigilated exam.
- paraphrase adequately all material in their own words.

Students are required to confirm as part of each submission:

- that the work they are submitting for the open-book examination is entirely their own work, except where otherwise indicated; and
- that they have not copied from the work of any other candidate, nor consulted or colluded with any other candidate during the examination.

Honour Code Pledge

All students will be expected to confirm for each open-book or closed book remotely invigilated examination the following:

- **I acknowledge the University Honour Code** and **I hereby confirm** that the submitted work is entirely my own and I have not (i) used the services of any agency or person(s) providing specimen, model or ghostwritten work in the preparation of the work I submit for this open book examination; (ii) given assistance in accessing this paper or in providing specimen, model or ghostwritten work to other candidates submitting for this open-book examination."

3.9 Penalties for non-attendance

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

3.10 Penalties for late submission of open-book examination scripts

Candidates should upload their submission within the time allowed for their online examination (inclusive of any additional time for exam adjustments and technical time). Candidates who access the paper later than the published start time (and who do not have an agreed alternative start time) will still need to finish and submit their work within the originally published timeframe or be considered to have submitted late. Candidates who access the paper on time but who submit their work after the published timeframe will also be considered to have submitted late.

Where candidates submit their examination after the end of the specified timeframe and believe they have a good reason for doing so, they may submit a mitigating circumstances notice to examiners (MCE) to explain their reasons for the late submission. The Exam Board will consider whether to waive the penalties (outlined below) for late submission.

The penalties will be applied at the paper level and are as follows:

Time	Penalty
First 5 minutes	No penalty
6 minutes onwards	Fail

Penalties will only be applied after the work has been marked and the Exam Board has checked whether there are any valid reasons for late submission.

4. PROGRESSION RULES AND CLASSIFICATION CONVENTIONS

4.1 Qualitative descriptors of classes (FHS)

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

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

In reaching their decisions the examiners are not permitted to refer to a candidate’s outcome in, or profile across the assessments in, the First Public Examination (‘Prelims’).

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

4.2 Classification rules (FHS)

Part I:

The examiners are required to classify each candidate according to her/his overall average mark in Part I as (a) worthy of Honours, (b) Pass or (c) Fail. The examiners do not divide the categories further but tutors and students may infer how well they have done from their marks.

Unclassified Honours –A candidate is allowed to proceed to Part II only if he/she has been adjudged worthy of honours by the examiners in Part I and normally obtained a minimum mark of 50% averaged over all elements of assessment for the Part I Examination.

Candidates adjudged worthy of honours and obtaining a minimum mark of 50% averaged over all elements of assessment for the Part I Examination normally proceed to Part II but they may, if they wish and subject to approval from the relevant bodies, leave after Part I in which case an Unclassified Honours B.A. degree will be awarded.

Candidates adjudged worthy of honours who do not obtain a minimum mark of 50% averaged over all elements of assessment for the Part I Examination may, if they wish and subject to approval from the relevant bodies, leave after Part I in which case an Unclassified Honours B.A. degree will be awarded or may retake Part I the following year (subject to college approval).

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

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

Part II:

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

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

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

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

4.3 Progression rules

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

> Section A. 8. No candidate for the degree of Master of Engineering in Materials Science may present him or herself for examination in Part II unless he or she has (a) been

adjudged worthy of Honours by the Examiners in Part I and (b) normally obtained a minimum mark of 50% averaged over all elements of assessment for the Part I Examination.

Section A. 11. To achieve Honours at Part I normally a candidate must fulfil all of the requirements under (a), (b) & (c) of this clause. (a) Obtain a minimum mark of 40% averaged over all elements of assessment for the Part I Examination, (b) obtain a minimum mark of 40% in each of at least four of the six written papers sat in Trinity Term of the year of Part I of the Second Public Examination, and (c) satisfy the coursework requirements set out in Section B, Part I [of the Regulations].

Section B. Part I. 3. In the assessment of the Materials coursework, the Examiners shall take into consideration the requirement for a candidate to complete satisfactorily the coursework to a level prescribed from time to time by the Faculty of Materials and published in the Course Handbook. Normally, failure to complete satisfactorily all six elements of Materials Coursework will constitute failure of Part I of the Second Public Examination.

4.4 Use of vivas

There are no vivas in the Part I examination.

In Part II, a *viva voce* examination is held for all candidates and in 2021 will be held using video-conferencing technology. The effectiveness of the video-conference provision will be tested in advance with each candidate and where this is judged to be inadequate the viva will be conducted by telephone conference call instead. In all cases provision will be in place to switch to a telephone conference call if on the day the video-conference technology/connectivity causes problems.

The purpose of the viva is to clarify any points the readers believe should be explored, and to ascertain the extent to which the work reported is the candidate's.

It is stressed that it is the scientific content of the project and the candidate's understanding of their work that is being considered in the viva.

5. RESITS

In the event that a candidate obtains a mark of less than 50% averaged over all elements of assessment of Part I, or if a candidate fails to satisfy the examiners, a resit is permitted. Such a candidate may re-enter for the whole of the Part I examination on one occasion only, normally in the examining session in Trinity Term 2022, following the examiners' original decision. The examination will cover the same material as the original examination and will follow the same rubric. If such a candidate is adjudged worthy of honours and achieves a mark of 50% or more averaged over all elements of assessment in Part I, the candidate may progress to Part II but will carry forward only a capped mark of 50% for Part I.

Part II may be entered on one occasion only.

6. MITIGATING CIRCUMSTANCES NOTICES TO EXAMINERS (MCE)

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

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

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

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

Whether under Part 12 or Part 13, a mitigating circumstances notice to examiners should be submitted by the college on behalf of the student as soon as circumstances come to light.

Candidates with alternative arrangements under Part 12 will not be considered under this mitigating circumstances process if they do not submit a separate mitigating circumstances notice.

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

For Part I, normally, this MCE meeting will take place before Part A of the meeting of the internal examiners at which the examination results are reviewed. When reaching these Part I decisions on MCE impact level, the internal examiners will take into consideration, on the basis of the information received, the severity and relevance of the circumstances, and the strength of the evidence provided in support. 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, on the basis of the information received, the severity and relevance of the circumstances, and the strength of the evidence. The banding information will be used at Part B of the meeting of Part II internal examiners, which is held after the vivas, at which the marks agreed following the discussion after the viva are reviewed and recommendations to the Finals Board formulated regarding any action(s) to be taken in respect of each MCE.

Further information on the procedure is provided in the *Examination and Assessment Framework, Annex E* and information for students is provided at 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.

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

7. DETAILS OF EXAMINERS AND RULES ON COMMUNICATING WITH EXAMINERS

The Materials Science Examiners in Trinity 2021 are: Prof. Hazel Assender, Prof. Nicole Grobert, Prof. Pete Nellist, Prof. Keyna O'Reilly, Prof. Jason Smith and Prof. Richard Todd. The external examiners are Prof. Geraint Williams, Swansea University, 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 2021 (For Part I and Part II students who embarked on the FHS respectively in 2019/20 and 2018/19)

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

	Component	Mark
Part I	General Paper 1	100
	General Paper 2	100
	General Paper 3	100
	General Paper 4	100
	Materials Options Paper 1	100
	Materials Options Paper 2	100
	Practicals	60
	Industrial visits	20
	Engineering and Society coursework	20
	Team Design Project	50
	Introduction to Modelling in Materials	25
	Characterisation or Atomistic Modelling module	25
Part I Total		*800*
Part II	Thesis	400
Overall Total		*1200*

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

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

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

Route 1

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

Route 2

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

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

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

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

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

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

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

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

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

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

ANNEX

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

Route 1

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

Route 2

	Component	Mark
Part I	General Paper 1	100
	General Paper 2	100
	General Paper 3	100
	General Paper 4	100
	Materials Options Paper 1	100
	Materials Options Paper 2	100
	Practicals	60
	Industrial visits	20
	Engineering and Society coursework	20
	Team Design Project	50
	Introduction to Modelling in Materials	25
	Characterisation or Atomistic Modelling module	25
	Literature-based research module	50
Overall Total		**850**

Reports from the External Examiners for Materials

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

Please complete both Parts A and B.

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

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

Part B

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

B1. Academic standards

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

The proportion of Part II students graduating with First class degrees this year is certainly higher than for the Russell Group overall (40% for 2019/20) but this is not a fair comparison as it does not take into account the higher entry grades achieved by Oxford students, nor the tendency within the sector to award more Firsts within STEM subjects. It is clear from both the Part I examination papers and the Part II research project vivas that students are expected to perform at a very high level, and in my view their achievements have been appropriately recognised compared with the institutions where I have worked.

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).*

As ever I enjoyed the opportunity to participate in the Part II research project vivas. Students coped very well with the videoconferencing arrangements. Compared to last year, I suspect this cohort benefitted from having gained experience with these tools throughout the year. They were articulate and demonstrated excellent knowledge of the technical detail. The need to adapt to changing circumstances related to COVID-19 during the year required flexibility and resilience, and I was impressed by how many had still clearly enjoyed their projects. As in previous years, some students had generated original results that could form the basis of published papers. I will comment on the written dissertations in section B4.

The Part I written examinations were very challenging (I will comment further in section B2) and as ever required the students to have mastery of the entire course taught during the first three years. Student performance is therefore very impressive. The academic standards applied both to the marking of examinations and coursework compare favourably to my own institution.

B2. Rigour and conduct of the assessment process

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

I reviewed the examination papers over Easter and found that they had been prepared to a high standard as usual, with very few errors. I received a comprehensive response to all of the suggestions and corrections that I made.

This year it was known that students would sit these papers remotely, and thus the questions had been designed to mitigate the fact that students would have access to their notes and other resources. A reduction in the average mark was observed this year, and having observed the same at my own institution, the benefit of hindsight suggests that this has to do with the time pressure of these examinations (still 3 hours for each paper with limited time to scan and upload answers), which means that candidates simply do not have time to sift through their notes to locate and extract relevant information. Hence those parts of questions that test recall had been made harder in anticipation of an advantage that does not exist in practice.

A concern that remains with remote examinations is the possibility of collusion, although again the significant time pressure mitigates this. The relatively small cohort should also make duplicate answers easier to detect. However if the University decides to continue with remote examinations for the 2021–22 academic year, then the use of proctoring software should be considered. My own recommendation would be that students sit examinations in person next year if at all possible.

I strongly support the approach that the examiners took to addressing the change in overall paper marks resulting from COVID-19: by applying a simple shift to bring the averages into line with recent years, they have facilitated transparency and avoided advantaging some students more than others than might be perceived as unfair.

The examiners are to be commended for the care and attention that they paid to cases of extenuating circumstances, especially given the increased volume arising from COVID-19. Some of the cases were very serious, and the approach combined fairness with compassion within the University's regulations.

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 of the pieces of coursework completed by students in groups is the business plan exercise, which is supported by teaching delivered by the Saïd Business School. I noticed that while the marks are clustered due to the groups, nevertheless the largest number appeared to score Lower Second class marks, which is not in line with their performance in other courses. Two contributing factors spring to mind: first, that this exercise contributes very little (2.5% by my calculation) to the final degree mark; second, that students might disengage from a bespoke course that they perceive to be disconnected from their degree programme. I recommend that the Department consider whether there is internal expertise that could be deployed to address this.

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.*

This year saw the first cohort of Part I students for whom the Introduction to Materials Modelling course is compulsory – a welcome development. Students write up reports on two investigations chosen from the four topics covered by the course. The course leader reported to the examiners that the first topic was extremely popular, and almost all students then attempted one of the second and third topics, with very few attempts at the fourth. Students who are overly focussed on marks may of course decide by the time the third topic has been taught that they can certainly write up two of those, and therefore disengage from the fourth. Reversing the order of delivery might be one way to see whether this is the case.

As a result of the above change, students now choose between an advanced modelling course and one on characterisation. I reviewed the coursework from the former, and thought that the open-ended mini-projects (choice of three) appear to be a very effective way to assess this. I did wonder about the feedback that students receive on their Part I coursework reports given that so much depends on the Part II project dissertation.

This year there was a wide disparity in some of the initial Part II marks – it is unclear to me whether this is due to lack of continuity of examiners and assessors or a limitation of the current marking guidelines. For example, overall descriptors do not help when a dissertation contains an excellent literature review but a very poor presentation and discussion of results. I recommend that the Department reviews these documents for next year.

My overall impression of this year's Part II dissertations was that they had not been prepared to the same standard as in previous years – I gained a sense that they had been finished in a hurry, e.g. from the frequency of simple errors that should have been spotted with proof-reading. This is surprising given the lack of extra-curricular activities this year, but might be explained if the relaxation of lockdown restrictions in the spring suddenly presented the opportunity to resurrect previously abandoned experimental work. If it is not already in place, then an official end to computational and laboratory-based work two weeks before the dissertation deadline might address this. There is a growing tendency to reuse diagrams from the literature in dissertations. While these were appropriately attributed, the danger is that they are not always explained well or wholly relevant, so students should be encouraged to create their own diagrams where possible. Since so much of the assessment falls on the quality of the dissertation, students should be encouraged to invest more time and effort in writing this.

From observing the vivas I also sensed that remote learning had an impact on understanding of background material. While students appeared to have been well-supported through videoconferencing in general, it is sometimes only in face-to-face conversations that misunderstandings are identified, so in some cases this only became apparent in the dissertation. In my own institution students only carried out their research work during the spring term this year, and so all projects were conducted remotely without laboratory access. When compared with the experience of Oxford students, it occurred to me that the ever-changing restrictions resulting from COVID-19 that necessitated making changes to plans midway might actually have been a greater disadvantage. As I mentioned above, students coped extremely well under the circumstances, no doubt as a result of the support from other members of the Department.

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 this has been an extremely challenging year for staff and students, and both should be commended for their efforts. The administration of the course and the examination process has again been administered to a very high standard and I am grateful to Ms Philippa Moss and Mrs Elleanor Thornton for ensuring that the relevant information was always available to me at the right time.

Signed:	Peter Haynes
Date:	7 July 2021

EXTERNAL EXAMINER REPORT FORM 2021

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

Please complete both Parts A and B.

Part A				
	*Please (✓) as applicable**	**Yes**	**No**	**N/A / Other**
A1.	Are the academic standards and the achievements of students comparable with those in other UK higher education institutions of which you have experience? *[Please refer to paragraph 6 of the Guidelines for External Examiner Reports].*	✓		
A2.	Do the threshold standards for the programme appropriately reflect the frameworks for higher education qualifications and any applicable subject benchmark statement? *[Please refer to paragraph 7 of the Guidelines for External Examiner Reports].*	✓		
A3.	Does the assessment process measure student achievement rigorously and fairly against the intended outcomes of the programme(s)?	✓		

A4.	Is the assessment process conducted in line with the University's policies and regulations?	✓		
A5.	Did you receive sufficient information and evidence in a timely manner to be able to carry out the role of External Examiner effectively?	✓		
A6.	Did you receive a written response to your previous report?			✓
A7.	Are you satisfied that comments in your previous report have been properly considered, and where applicable, acted upon?			✓
* ***If you answer "No" to any question, you should provide further comments when you complete Part B.***				

Part B

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

B1. Academic standards

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

The academic standards achieved by the vast majority of the students are very high across examinations, coursework and research projects and compare extremely favourably with other institutions offering Materials science and engineering degree schemes.

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 Materials Science MEng scheme has a very broad ranging syllabus, with an excellent balance of subject material, requiring a detailed knowledge of modules delivered over two years in part I examinations. The questions in both general and options papers were

suitably challenging and tested the student's analytical and problem-solving skills in addition to their ability to appropriately distil the course content. Despite the requirement to submit their answers in time-limited, online exams through the Weblearn online platform, the level of achievement by the students was generally good and there were relatively few examinations failed. From my scrutiny of a limited selection of online scripts, some of the answers submitted by the top students were outstanding and in line with the model answers. Generally for some of the weaker students, responses to the questions answered last were inadequate, probably as a result of struggles with the time deadline for online submission. Nevertheless, I would consider the level of performance of the students in part I exams to compare favourably with those on materials courses in other leading UK universities.

For part II, I was fortunate enough to evaluate several outstanding final year research projects, where both thesis and student performance in the viva were excellent and at a quality commensurate with an early stage doctoral student. The students who perhaps did not do as well were usually let down by a haphazardly structured and poorly written thesis, rather than a lack of understanding of the subject area. Again, student achievements in the research project aspect of the MEng course are generally excellent and again compare favourably with competitor universities in the UK.

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.

Oxford's Materials Science part I examination process differs considerably from the approach used by other UK universities of whom I have experience, where typically the module lecturers both set the exam papers and carry out the marking. Academic colleagues perform the role of second marker, where the checking is usually limited to evaluating the accuracy of totalling partial marks of individual answers in exam scripts.

Oxford's approach in using two independent academic examiners and double blind marking of the papers is more rigorous and fair, but also significantly more time-consuming. After marking, the two examiners must agree their final marks for each question where there is a divergence in apportioning marks according to the model answers. I was impressed by the quality and the rigour of the model answers, which I was able to evaluate in good time. I especially liked the comments supplied within the model answers which explained how the question tested aspects of the students' mastery of the subject matter over and above recall of the lecture note content.

The assessment of the part II research projects, which occupy the entirety of the MEng students' final year, also differs somewhat to the approach used in other universities, where the project supervisor usually plays a role in marking the final dissertation. Oxford's approach is to employ an examination board consisting of six senior academics, along with several additional assessors to mark student thesis submissions and to carry out the vivas. In addition the external examiners are invited to evaluate a selection of thesis submissions, participate in the viva questioning and where appropriate give an opinion on the final mark awarded. Due to the ongoing pandemic, vivas we carried out over MS Teams and worked very effectively with relatively few technical issues encountered. I was surprised that the students were not given an opportunity to share a short powerpoint presentation to help them in the opening of the viva when they are asked to explain the highlights of their research project. Maybe this is something to consider if this format is required in coming years? The project assessment process is both rigorous and fair and the marking rubric/comment sheet completed by the examiners is suitably detailed, allowing clear evaluation of the strengths and weaknesses of each thesis and how the marks were apportioned.

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?

Although mitigating circumstances were handled in line with university regulations, there were an inordinately large quantity to deal with in this year's external exam board meeting. Consequently the anonymised procedure for dealing with MCs dominated proceedings. I realise that this Covid-affected academic session is exceptional and that such large numbers are unprecedented and maybe should not be anticipated in the coming years. However, I believe that much of the discussion around MCs could have been done prior to the external exam board meeting and that these decisions could have simply been ratified in the presence of the external examiners.

During the assessment of part II thesis submissions, there were several examples encountered where there was a large divergence (by 15-20 marks) in the marks awarded by the two examiners/assessors and consequently I was given an opportunity to intercede. Although a consensus was reached amicably, I feel that maybe some additional guidance should be provided to the examiners on what exactly constitutes a good thesis. There were a few instances where individual examiners had awarded high marks due to the challenging nature of the research, rather than the quality of the write up. I also note that students are told that the use of a personal writing style is acceptable for their thesis, where this would not be the case in the preparation of say, a research paper.

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.*

As mentioned in section B2, the additional information included in model answers to explain how various parts of the questions tested different aspects of the students' understanding, over and above simply regurgitating sections of lecture notes, was highly commendable.

B5. Any other comments

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

I'd like to extend my gratitude to Ms Philippa Moss and Ellie Thornton for their help (and patience) in guiding me through the various external examiner requirements in my first year of appointment. My overall impression is that the MEng Materials Science course offers a high standard of education in the subject area and produces very high quality graduates, many of whom I'm sure will become future leaders in this field.

Signed:	Geraint Williams.
Date:	19/7/2021

Faculty of Materials

Department of Materials Academic Committee

RESPONSE TO EXAMINERS' REPORTS 2021

Faculty of Materials
Department of Materials Academic Committee

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

We are very grateful to the external examiners for their very positive contributions to the examining process, and also the insightful comments they have provided. The reports have been reviewed by the Department of Materials (undergraduate) Academic Committee, DMAC, and have also been seen by the Faculty. DMAC are reviewing whether there is any effect of gender on the student performance (at prelims, part I and part II).

We are pleased that the examiners agree the necessary move to open book examinations during the COVID pandemic was handled well. We have reviewed this experience, and have noted the impact it had on the students during the examination process. A decision has been made at Faculty to return to closed book examinations for all written papers for this academic year and onwards. Careful attention will continue to be paid to the design of questions, with a particular effort on the avoidance of questions that depend on rote learning and derivations that have been 'seen' in lectures. We will also continue to ensure the questions are designed to be suitable tests for the full range of the students' abilities, and we look forwards to engaging with the external examiners in the review of these exams as usual. DMAC will start a review of our examinations processes, which may lead to recommendations for changes in the longer term; there are some potential benefits for instance in invigilated open book examinations that current constraints on examination processes in the university do not allow us to use.

With regard to the Part II theses and potential differences in the assessors' interpretation of the assessment guidelines that led to disparities prior to reconciliation, DMAC is undertaking a review of the marking guidelines and the guidance to the examiners and assessors. Any revisions to the guidelines will be in place for the 21/22 examinations and will be communicated to students early in Hilary term. We think it is important to viva voce all students, and it is our view that there is greater benefit to the students in using the limited time of the oral examination for the assessors to clarify areas of concern or disparity, rather than request students to give a formal presentation. There is an opportunity for students to present their work during Trinity term, which is not assessed. We expect to return to in-person vivas in 21/22.

DMAC will review, with the modelling coordinator, whether feedback can be given to students following the modelling courses, which are taken by students at years 1 and 3. For those taking the year 3 course, all the classes in the first week are compulsory, so all students complete classes on each of the modelling topics before the modelling projects are distributed.
We note the comments on the business plan coursework. This component is now overseen by a member of the Materials faculty, and we expect this will address the perceived disconnect by students.

The number of Mitigating Circumstances (MC) for discussion was substantial due to COVID, and the main discussion on the Part I MCs was done internally as usual. However, the tight schedule of examiners meetings does not allow the Part II MCs to be discussed separately from the meetings that involve the external examiners, though they do not need to be present for this part. We expect to retain the same schedule of meetings in 22/22, but will give clearer guidance on which parts of the meetings require the attendance of the external examiners.