

## NATURAL SCIENCES TRIPOS SENIOR EXAMINER'S REPORT

**SUBJECT:** Part II Genetics, and BBS Genetics (Major)

**Senior Examiner:** Prof Cahir O'Kane

**Examiners:** Prof Frank Jiggins (Internal)  
Prof Aoife McLysaght (External, Trinity College, Dublin)

### **Structure of the examination:**

#### **i) Part II Genetics (NST2GN)**

##### **Written paper/s:**

- Papers 1 through 4, (each 16% of final mark) three-hour papers, each corresponding to one of four modules.
- Integrated paper (10% of final mark), a two-hour paper

##### **Assessed components:**

- Literature Review (10% of final mark) - completed during the Christmas vacation
- Research project performance and report (16% of final mark) - undertaken in Lent term

##### **Viva Voce:**

The External Examiner gave each of the 12 NST2GN students a 15-minute *viva*, in randomised order. These were in person. Viva performance is not an assessment that contributes to marks, but is taken into account when considering borderline candidates, as well as gauging overall quality of the course.

#### **ii) BBS**

*Major Subject:* Two candidates took Genetics as their major subject:

- Four written papers, the same as Papers 1 to 4 for Part II Genetics sat alongside Part II Genetics candidates (64% of final mark),
- Dissertation (20% of final mark); one student undertook their dissertation in Genetics, the other on a genetics-related topic in Biological Anthropology.
- Minor subject (16% of final mark). Both students took Comparative Human Biology (ACT2BA paper B4).

BBS students are not invited for vivas.

We understand that one BBS student registered for Genetics Paper 2 (BBS course code 83) as their minor subject but did not sit the examination.

**iii) Module 2 (Early Development and Patterning: Genetic and Cellular Mechanisms) – a shared paper.** Genetics Module 2 is also offered as a Lent term option to those taking NST2 Zoology (aka paper ZM10; 5 students) and NST2 PDN (aka paper P4; 5 students), and as a major subject option to students taking NST2BBS Zoology (paper 11\_8; 6 students) or PDN (Paper 2\_4; 2 students).

The conduct of the examination was identical to that observed for Genetics candidates. The scripts from Zoology and PDN students were processed by their respective departments.

This was a new module this year, albeit overlapping significantly with a previous Developmental Biology option. Students were provided with a specimen paper at the start of the academic year.

**iv) Module 4 (Evolutionary Genetics & Adaptation) – a shared paper.** Genetics Module 4 is offered as a Lent term option (aka ZL5) to those taking NST2 Zoology (5 students) or NST2 Plant Sciences (1 student). It is also offered as a major subject option to students taking NST2BBS Zoology (paper 11\_17; 6 students) or Plant Sciences (paper 9\_10; no students).

The conduct of the examination was identical to that observed for Genetics candidates. The scripts from Zoology students were processed by the Department of Zoology, whereas the scripts from the single student taking module 4 as an NST2 Plant Sciences paper were marked with the Department of Genetics students, with the marks, comments and moderator comments forwarded to the Plant Sciences examiners.

**Number of candidates:** 12 NST2GN; 2 NST2BBS Genetics Major. Two further candidates intermitted before the examination.

A further 18 students sat our Paper 2, and a further 12 students sat our Paper 4, under all exam codes for shared papers and BBS minor options. These numbers are broken down further in the above sections on Modules 2 and 4, and in Table 1.

**Table 1: Numbers of candidates sitting Genetics Papers**

Paper	NST2 GN	BBS GN major	NST2 ZO, ZL5 or ZM10	BBS ZO major, 11_8 or 11_17	NST2 PDN P4	BBS PDN major 2_4	NST2 PL ZL5	Total
1	12	2	0	0	0			14
2	12	2	5	6	5	2		32
3	12	2	0	0	0			14
4	12	2	5	6	0		1	26
IP	12	0	0	0	0			12

**Number sitting the exam/s outside the main exam hall/s:** none

## **Conduct of the Examination:**

### **Setting the written papers**

The format of the exam papers was identical to that in the previous year 2022-23. However, we returned to closed-book sitting, and pre-pandemic time limits of three hours for Papers 1 to 4 (all with a choice of 3 questions out of 7 as before) and two hours for the Integrated Paper (IP) with a choice of one question out of seven as before.

This information was shared with the class in a briefing on 8 November 2023 and also posted on Moodle. Further briefings were made to the class (6 February 2024 and 1<sup>st</sup> May 2024) but the form and conduct of the examinations did not change from that presented at the start of the year.

A call for suggested questions was circulated to all lecturers on 1st Feb 2024, with a shared google folder provided for each assessor to upload their material. Question setters were also required to

supply outline answers. The Genetics papers were drafted by the examiners in consultation with each Module Organiser. Revisions were requested from some lecturers. Those approached responded quickly and effectively. Drafts of the Genetics papers were shared with the External Examiner at the end of March, who approved the questions. Rubrics were based on a template agreed across Part II NST Biology departments. All paper rubrics listed the NST2GN subject code and the relevant NST2BBS codes. In addition, Papers 2 and 4 also carried codes for NST2PDN, NST2ZO and NST2PL (but only the Genetics paper title i.e. "Paper 4: Evolutionary Genetics & Adaptation").

The Senior Examiner and the Exam Administrator were nominated as Departmental contacts for submission of examination papers.

## **Conduct of assessments**

### **i) Coursework:**

**NST2GN Literature Review and Project report.** The submission deadline for the Literature Review was 17 January 2024 and for the Project Report 25 March 2024. NST2GN candidates were asked: (i) to submit the title and scope of their Literature Review, as agreed in a meeting with the PI hosting their research project, by the end of Michaelmas Full term; and (ii) to arrange a feedback meeting with the PI, to discuss their Project Report, by the end of the Lent Full Term.

**BBS Dissertation.** Deadlines were as set by the Faculty of Biology: Title/proposal approved - 9 November 2021; last day for title change - 18 March 2022; submission - 29 April 2022.

No candidates self-certified to extend the Literature Review submission deadline. Two candidates requested a self-certified extension for submission of their Project reports, for reasons that appeared justified: one candidate requested a 2-day extension for minor illness, and a second candidate requested a 1-week extension due to loss of data during a cyber-attack on their department.

All coursework was double-marked, and differences of  $\geq 10\%$  were resolved by inviting the two assessors to discuss their marks, and either revising their marks, or leaving them unchanged, in which case a 3<sup>rd</sup> assessor would have been sought. In all such cases (four Literature Reviews and two Project reports), discussion between the original assessors led to mark revisions that differed by less than 10%, in most cases significantly less.

All coursework was submitted to Turnitin and the output files reviewed by the senior examiner. No cases of plagiarism, or poor scholarship requiring action, were identified in the coursework by (or independent of) Turnitin.

### **ii) Written papers**

The written papers took place online on the Inspira platform, with times and venues timetabled centrally, starting at 9am on 28, 29 and 30 May (Papers 1, 4 and 2 respectively), and 3 and 4 June 2024 (Papers 3 and IP respectively). At least one of the Internal examiners was available via mobile phone to answer any queries, but no queries were received during the examinations. Papers 1 to 4 passed off without any recorded incidents.

The timetabling of the papers was appropriate. Due to central timetabling and the constraints of shared papers, the papers were not all scheduled in numerical order, but the students were alerted to this beforehand and we are not aware of any problems arising.

Integrated paper incident. During the IP, the Senior examiner by chance attended the last 10 minutes as well as the prescribed first 20 minutes, and witnessed two candidates unable to write due to problems with Inspira. The Inspira technicians were attempting to resolve this by phone with the University Inspira team, and this resulted in the two candidates having to remain for around 30 minutes longer.

- One candidate ("A") had had at least one Inspira crash and had lost some of their written material, and the candidate was advised to continue writing once Inspira could be restarted. The student was advised to use prescribed routes such as the EAMC if they believed themselves to be disadvantaged. As described below, screenshots of the material that was lost were subsequently retrieved and made available to markers.
- The second candidate ("B") appeared to have run out of power due to their power cable not reaching from their desk to a power socket. The candidate was allowed an extra 5 minutes to compensate for the loss of power, but this was not resolved before the end of the exam, and so the candidate was unable to re-enter the exam. Authorising this on Inspira seemed to take around half an hour after the end of the exam.

Apart from the situations of the two individuals, the whole event was possibly disruptive for the other candidates. There was considerable movement of exam personnel around the two candidates, movement in and out of the room, and audibly loud voices during conversations held by exam personnel outside the room.

Beyond the incidents in the hall during the examination, the examiners had additional difficulties with the return of scanned material and scripts from IP paper, described below.

### **iii) Marking and return of scripts**

**Return and processing of scripts.** At the end of each exam period, scripts were made available immediately to assessors by the Inspira system, via a link that had been circulated to them a day or so beforehand. However, because scanned material was not yet available, the examiners felt it necessary to alert assessors to the fact that they should not begin marking until scanned material appeared, with an expectation that this would take two working days.

Once scanned material was available, all assessors acted promptly, returning marked scripts within the prescribed turnaround time of 2 working days – many returned scripts within a day, in order to make up time lost due to delays in appearance of scanned material. In a few cases examiners had to chase up assessors who had overlooked that they had to follow a separate Inspira link for each exam code for the paper they were marking. To insure against difficulties with unfamiliarity of the Inspira interface, we asked assessors to return their marks via both Inspira and a dedicated google marksheet for that question, to which they were also asked to add comments justifying their mark. Having two records of each mark also helped us to correct a transcription error by an assessor in one case.

### **Inspira issues.**

**(i)** One major problem with the Inspira workflow was the delay in obtaining uploads of scanned material attached to each script. We learned at the beginning of the exam period that there would

be a delay of 2 days after each paper in obtaining this. While we had not expected such a long delay, we could still have coped with a 2-day delay without major difficulty (beyond some inconvenience to assessors who had set aside time in their diaries for marking these scripts). However, the delay was more usually three days, and in the case of the IP, we only received scans after 9 days, after our planned final examiners' meeting, which as a result we had to adjourn. Fortunately, we received the final scans the next morning (I understand that they had to be rescanned), and the relevant assessors were able to mark them within a few hours, allowing the examiners to review the marks and resume their final meeting later that day.

(ii) One IP script was initially missing (from candidate "B", who had power supply problems), and only appeared 6 days after the paper was sat, after notification of the missing script to the University Inspira team 3 days after the paper.

(iii) We were aware of missing material from the IP for candidate "A". The Inspira office were unable to recover this, but Prof Dee Scadden (Biochemistry Dept) kindly re-examined the Inspira logs and screenshots. The Inspira logs showed conflicts with apps on the candidate's laptop which had been left running by the candidate, and were presumably the causes of Inspira crashing. The screenshots did however retrieve the lost written material, and we were able to mark the entire question.

(iv) A candidate had submitted either no or only very short text or bullet points, thus gaining low or zero marks on those questions, and despite some good marks on other questions. We were concerned that they may have lost some work due to Inspira problems. The Inspira team reported back that there were no losses of material, although it was not clear to us what the basis for this assertion was. Prof Scadden therefore re-examined logs and screenshots of these papers from this candidate, and was able to confirm that the lack of material was indeed not due to material lost on Inspira. The ability to review Inspira screen recordings therefore allowed us to exclude technical issues that could have disadvantaged candidates.

**Turnitin and Plagiarism.** In parallel the scripts were reviewed using Turnitin by the Senior Examiner, with the Turnitin officer evaluating outputs. No examples of either plagiarism (which in a closed-book environment would be likely to be self-plagiarism) or poor scholarship were found.

#### **iv) External Examiner and *vivas***

The External Examiner carried out 15-minute *vivas* for the 12 NST2GN candidates in person on 12 June 2024. She was provided in advance with all scripts, coursework and assessment material of both the NST2GN and BBS candidates, and access to the course Moodle site. Students had been informed beforehand during the SE class briefing that the purpose of the *vivas* was to help give the external examiner a better sense of the quality of the course and the examination, and to help the examiners define class boundaries for borderline candidates, with no candidates losing any marks as a result of their *viva*.

#### **Marking/Scaling:**

We followed the Faculty of Biology marking scheme and classing criteria for essay questions, with additional guidance to promote consistency in the First Class and Fail ranges, where we felt the Faculty guidelines needed additional detail. We also required assessors to select a restricted set of

marks, e.g. 62, 65 or 68 for low, medium or high 2.1, respectively, and avoid marks on a class boundary such as 60 or 70.

The internal examiners undertook moderation of all questions, divided as two papers each across Papers 1-4, and rereading at least five scripts for each answer, from across the range of marks awarded. Both examiners reread all the IP answers. We paid particular attention to less experienced assessors, and if more than 2/5 answers appeared to have been under-or-over marked, we reread all the scripts from that assessor. We felt that the comments made by assessors were very fair and were good reflections of each script. The most common situation when we felt moderation was necessary was when the assessor comments corresponded better to a slightly different grade when following the Faculty of Biology classing criteria, in most such cases moderation raised the mark slightly. All moderated marks were approved by the External Examiner, who also had access to all raw marks, assessor comments, and scripts.

**Shared papers (Paper 2/ZM10/P4 and Paper4/ZL5).** Scripts from candidates who sat Papers 2 and 4 as part of NST2ZO and NST2PDN, or NST2BBS candidates with Zoology or PDN as major subjects were marked by the same assessors as for NST2GN, but with separate marking instructions, processing, and moderation overseen by the Zoology or PDN examiners.

We reviewed the marks of one candidate who had a combination of very low marks and good marks. As reported above, we eliminated the possibility of loss of material on Inspera, and agreed with the marks awarded by assessors on the basis of what had been submitted.

**Table 2: Statistics for numbers of scripts per question, and average/SD per question and per paper.**

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<b>Paper 1</b>	<b>Paper Totals</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>
Number	14	7	8	6	3	4	8	6
Mean	60.79	54.6	58.6	57.8	66.7	51.8	64.1	72.5
SD	12.35	29.4	6.1	14.0	18.9	9.7	3.4	15.9
<b>Paper 2</b>	<b>Paper Totals</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>
Number	14	10	7	3	12	5	1	4
Mean	61.45	60.3	57.4	70.7	64.3	59.6	52.0	62.0
SD	8.38	10.1	11.1	7.5	10.2	6.7	-	13.2
<b>Paper 3</b>	<b>Paper Totals</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>
Number	14	8	2	4	6	12	8	2
Mean	61.05	62.4	60.0	44.0	66.8	62.8	60.6	65.0
SD	9.44	13.4	2.8	27.7	9.6	9.4	9.5	14.1
<b>Paper 4</b>	<b>Paper Totals</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>
Number	14	12	10	6	3	4	2	8
Mean	59.33	56.9	65.4	47.8	71	60.0	62.0	58.6
SD	7.36	7.2	4.1	21.7	11.5	4.4	0.0	8.8
<b>IP</b>	<b>Paper Totals</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>Q6</b>	<b>Q7</b>
Number	12	1	2	0	2	1	2	3
Mean	67.17	55.0	57.3	-	74.0	58.0	70.0	77.7
SD	10.82	-	5.0	-	8.5	-	7.1	8.7

### Assessed work:

**Literature Review:** Mean mark 67.25; SD 5.89

**Project:** Mean mark 67.69; SD 6.25

**Table 3. Class Distribution (NST2GN)**

<i>Grade Distribution</i>	ALL		MALE		FEMALE		NST		MVST	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
<b>Class I</b>	3	25%	2	40%	1	14%	3	43%	0	0%
<b>Class II division 1</b>	5	42%	0	0%	5	71%	1	14%	4	80%
<b>Class II division 2</b>	4	33%	3	60%	1	14%	3	43%	1	20%
<b>Class III</b>	0									
<b>Fail</b>	0									

The male/female difference appears slightly significant ( $P=0.047$ , Fisher's exact test), although this appears to be due to a bimodal distribution for males; numbers are relatively small, and comparison of individuals' actual marks showed no significant difference ( $P>0.5$ , Mann-Whitney test and unpaired t-test).

There was no significant effect of NST vs MVST Tripos ( $P=0.12$ , Fisher's exact test).

### Subject Examiners' Meeting:

The two internal examiners and the external examiner met in-person for this on Wednesday 12 June 2024. At this stage we did not yet have the missing material for Candidate "A" from the IP paper, nor scans for this paper which had been sat 8 days previously. However, since we were only aware of scans for 2-3 scripts, we had asked assessors to provide provisional marks on the basis of what they had available. Using these marks, we reviewed the mark distribution across all papers. All marks were awarded on a scale of 100 according to the marking scheme and class boundaries approved by the Committee of Management for the Natural Sciences Tripos.

There was some discussion regarding the two highest highest-ranked 2.1 candidates. The examiners reviewed their marks on grounds of some of the assessor comments and re-read some of their lower-scoring scripts. Together this increased the candidates' marks, in one case enough to cross the class boundary.

The External Examiner accepted this and all the other marks as robust, except for the IP marks, due to the missing part of one script and missing two scans. We therefore felt unable to sign off the class list and marksheet and adjourned until the afternoon of Thursday 13<sup>th</sup> June, to give one more day for either the missing material to arrive, or for guidance from the Examinations Office on how to proceed. Fortunately, we received screenshots of the lost text from the IP script of Candidate "A", and the assessor was able to remark the entire script the next morning, awarding a higher mark. We also received the two missing scans, and the respective assessors were also able to remark these scripts the following morning, in one case awarding a higher mark. The examiners also re-read the complete scripts and agreed with the revised marks.

The examiners were therefore able to reconvene for an online meeting on the afternoon of Thursday June 13<sup>th</sup>. The revised marks were accepted, as were all the other original marks for the

IP paper. This led to slightly higher marks for two candidates compared to their provisional marks the previous day, but did not take either candidate across or close to a class boundary. We noted the proportion of Firsts at 25% as being close to typical (Table 3). We noted the higher frequency of 2.2 grades compared to recent years, but agreed that given the relatively small numbers this was not a large deviation, and were satisfied with the robustness of the marks.

The examiners therefore signed off on the class list and class marksheet, and awarded the Thoday Prize to the best overall performance.

The grade roster was uploaded to CamSIS on 14 June 2020 and the mark book and class list also sent to the Student Registry.

### **Administration:**

No issues beyond those raised elsewhere about Inspira.

### **Conclusions and Recommendations:**

Academic examination issues. From an academic perspective, we believe that the Part II Genetics examinations went well. Questions were challenging but well received, papers came across as balanced, and the quality of answers was in general good, with some outstanding. Our assessors worked promptly, and to a high standard, requiring no more than minor moderation. We are not aware of any major issues about the content of the examination or the standard of assessment.

Assessment issues. The external examiner commented positively on the clear criteria for marking, and on the system of moderation by the two internal examiners with final approval by the final examiners' meeting, which favoured consistency of moderation. She made two recommendations to clarify or procedures:

- To review procedures for resolving mark discrepancies between assessors for Literature Review and Project work. In particular (1) Is  $\geq 10\%$  too high a threshold to trigger resolution, and (2) Is the aim of resolution to obtain an agreed mark, or two marks within an acceptable range that can then be averaged?
- Where examiners have proposed moderating marks, that the comparison between raw and moderated marks be easier to find.

Course issues. The external examiner noted the students' universally positive feedback on the course, its breadth (which was broader than they had expected), its delivery and administration. The projects and SAG sessions received special mention. Some more specific suggestions for the Department:

- The Department could perhaps make more of the breadth of the course, and students' responses to it, as a positive selling point to Part 1B students considering their Part II choices; Part 1B students had a much narrower impression of the Part II course and were pleasantly surprised by its breadth after taking it.
- MVST students found it initially harder to get up to speed. Perhaps some more focused guidance or support, beyond providing the most relevant Part 1 handouts 2 weeks before the course, would help. A cheat-sheet to explain the most widely used experimental approaches, that NST students would have covered in more detail, would also help.



- Sometimes supervisions took place only after a gap after the end of the relevant lectures; closer to the end of the lectures would be better, while material is still fresher in students' minds.

Inspira. Inspira made the distribution of scripts efficient, and had the considerable advantage that all scripts were legible. The Inspira problems above appear to largely relate to the administration of the system and need attention, and we see the advantages of the Inspira system if it works well.

- Scans need to be attached to scripts within a defined time that is known sufficiently in advance that it can be accommodated in the timetable of marking, examining and release of the class list. We could live with the 2-day turnaround notified at the start of the examination period, even though it lengthens the time taken to produce a class list from our previous schedule. Unanticipated delays create major difficulties.
- There needs to be prompt notification to examiners when delays occur – we only knew when this happened by monitoring Inspira ourselves, and we only had a mail about this from the Inspira Team a few days later (apart from our urgent queries about the IP)
- It is important that students are not running any software that can cause Inspira problems. We are aware that students already receive instructions on certain software, but it is worth looking at whether these are clear and comprehensive enough to cover the conflicts arising, and that the importance of following these instructions is stressed.
- We would like more detailed reporting from the Inspira team of investigations into candidates' activity and Inspira events – while the Team reported their conclusions of one investigation and these proved correct, it was not clear to the examiners how these were arrived at, until they were repeated by Prof Scadden.
- Exams should be set so that assessors of individual questions only have access to their own scripts (although access to the entire set of questions). While we are not aware that we had any problems because of this, there is scope for unconscious bias coming from awareness of other assessors' marks, or even accidental or deliberate changing of other assessors' marks. This is possible with the existing Inspira software.

Timing of vivas and final examiners' meeting. Alongside improvements to Inspira procedures, future Part II Genetics examiners may consider postponing their final examiners' meeting by a few days. While the current schedule has worked well until now, this would allow a few more days to sort out any delays.

Exam codes. Another area for improvement is the proliferation of exam codes. While we understand the history and rationale for this, sharing of papers between courses has resulted in as many as 7 codes for one of our papers, complicating many steps in the process from paper uploads, generating lists of candidates, dividing examination responsibilities between departments, and tracking down all the scripts on Inspira after the exam – these complications both take more time to manage all through the process, and increase the chances of procedural errors by examiners, administrators, and assessors.

**Senior Examiner**      **Cahir O'Kane**  
**Date:**                      **1<sup>st</sup> July 2024**