Programme Information & PLOs

This document forms part of the Programme Design Document and is for use in the roll-out of the York Pedagogy to design and capture new programme statement of purpose (for applicants to the programme), programme learning outcomes, programme map and enhancement plan. Please provide information required on all three tabs of this document.

Title of the new programme – including any year abroad/ in industry variants

MSci & BSc Natural Sciences specialising in Mathematics

Level of qualification

Please select:	7

Please indicate if the programme is offered with any year abroad / in industry variants	**Year in Industry** Please select Y/N	No
	Year Abroad Please select Y/N	Yes

Department(s):
Where more than one department is involved, indicate the lead department

Lead Department	Natural Sciences
Other contributing Departments:	Chemistry, Mathematics, Physics

Programme leadership and programme team

Please name the programme leader and any key members of staff responsible for designing, maintaining and overseeing the programme.

Jason Levesley (Ch. BoS), Roddy Vann (Prog. Director), Eric Dykeman (Maths), Andy Parsons & Glenn Hurst (Chem), Laurence Wilson (Phys)

Particular information that the UTC working group should be aware of when considering the programme documentation (e.g. challenges faced, status of the implementation of the pedagogy, need to incorporate PSRB or employer expectations)

With few exceptions the modules which make up any of the Nat Sci programmes are drawn from the corresponding contributing single subject degree programmes. Local pedagogical practices and modes of assessment are honoured in Nat Sci unless there is evidence that such practices would not be pedagogically sound. Therefore, given the nature of the Nat Sci programmes parts of this document draw liberally from, or make reference to, the corresponding documentation from the contributing departments. This documentation should therefore be considered in parallel with the corresponding proforma for the single subject degree programmes of the contributing departments.

There are a couple of modules in Stage 4 of the single subject maths programmes which are not due to be mapped until (Summer term 2018) and the details of exactly what modules will be offered are not yet known. Thus these modules haven't been included in the Programme Map.

Who has been involved in producing the programme map and enhancement plan? (please include confirmation of the extent to which colleagues from the programme team /BoS have been involved; whether student views have yet been incorporated, and also any external input, such as employer liaison board)

The people listed in 14 item have primarily being responsible for the programme map and enhancement plan. At all stages the BoS has had free access to and being invited to comment on the documentation. Student input has been fed into the YP process in a focus group, through the SSLC and via the BoS.

Purpose and learning outcomes of the programme

Statement of purpose for applicants to the programme
Please express succinctly the overall aims of the programme as an applicant facing statement for a prospectus or website. This should clarify to a prospective student why they should choose this programme, what it will provide to them and what benefits they will gain from completing it.

All Natural Science programmes at the University of York aim to produce leaders in science, technology and industry who will have the interdisciplinary knowledge and skills to succeed in complex research and business environments. You will learn how science is conducted in different disciplines, how to operate within different methodological communities, and how to apply techniques and ideas across multiple disciplines.

As a Natural Sciences student specialising in Mathematics you will primarily study in the Department of Mathematics where you will take a carefully chosen suite of modules designed to fit in perfectly with other science based subjects such as Chemistry and Physics. In taking these modules you will develop your mathematical skills to be able to confidently analyse complex or unfamiliar problems using mathematical principles. Throughout the degree the core mathematical skills relevant to an interdisciplinary scientist, will be developed to a high level of sophistication, and your reasoning skills will be sharpened, as you are guided to use mathematics in deeper and more interesting ways. You will develop other skills which will be valuable throughout your career, such as computer programming and the ability to write on technical subjects with clarity and precision.

You will experience a variety of ways of learning and working, through lectures, small group seminars, group and individual projects, under the careful guidance of our dedicated staff, all of whom are engaged in current research and many of whom are world leaders in their field. As a Natural Science student you will get to see how mathematics is used in other disciplines and be able to undertake lab work to complement the more traditional classroom-based teaching common to all mathematics degrees. In the final year you will use your knowledge, understanding and skills to write a dissertation on a topic of your own interest, under the supervision of an expert mathematician. By the end you will have knowledge of an important subject with many applications in the modern world.

As a student on the MSci programme you will achieve all the above, but your skills will be developed even further and to a deeper level as you undertake an extended final year research project and more advanced lecture courses that will move you towards the research frontier in mathematics, giving you the expertise, skills and experience necessary to pursue graduate level research in mathematics both within and outside academia.

Programme Learning Outcomes

Please provide six to eight statements of what a graduate of the programme can be expected to do.

Taken together, these outcomes should capture the distinctive features of the programme. They should also be outcomes for which progressive achievement through the course of the programme can be articulated, and which will therefore be reflected in the design of the whole programme.

PLO	On successful completion of the programme, graduates will be able to:
1 BSc	use the language of mathematics and confidently identify problems in mathematics or experimental sciences that can be analysed or resolved by standard mathematical techniques. This includes the ability to apply those techniques successfully in the appropriate context.
1 MSci	use, with a high level of confidence and sophistication, the mathematical language and tools that underpin a wide range of research in, and applications to, science, technology and industry
2 BSc	recognise when an unfamiliar problem in a scientific discipline is open to mathematical investigation, and be able to adapt and/or synthesise a range of mathematical approaches (including abstraction or numerical approximation) to investigate the problem
2 MSci	recognise when an unfamiliar problem in any science related discipline is open to mathematical investigation, and be able to formulate their own strategy for the process of such an investigation
3 BSc	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical nature, and be able to justify the mathematical principles they choose for such a critique
3 MSci	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical context, and develop independently their own ideas using well-founded reasoning,
4 BSc	conduct a study into a specialised area, by researching material from a variety of sources, and synthesise this material into a well-organized and coherent account.
4 MSci	conduct, both independently and as part of a group of peers, a study of a specialised area of mathematics which takes into account recent mathematical progress. They will be able to compare and synthesise multiple sources to produce this study, and be able to check or complete technical details from these sources independently,
5 BSc	communicate complex mathematical ideas clearly in writing, at a level appropriate for the intended audience, and also be able to provide an effective summary of these ideas for non-specialists
5 MSci	communicate advanced mathematical ideas clearly, in writing and in a presentation, at a level appropriate for the intended audience,
6 BSc	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.
6 MSci	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.
7 BSc	Exploit the synergies between Mathematics and other science based disciplines by using the principles themes, concepts and methodologies of Mathematics as appropriate to a Natural Scientist.
7 MSci	Exploit the synergies between Mathematics and other science based disciplines by using the principles themes, concepts and methodologies of Mathematics as appropriate to a Natural Scientist.

8 BSc	
8 MSci	

Programme Learning Outcome for year in industry (where applicable)
For programmes which lead to the title 'with a Year in Industry' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year in industry b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year in industry by alteration of the standard PLOs.

NA

Programme Learning Outcome for year abroad programmes (where applicable)
For programmes which lead to the title 'with a Year Abroad' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year abroad or b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year abroad by alteration of the standard PLOs.

PLO8 Have confidence in being able to adapt to the demands of working for an extended period in a foreign country, which include working in another language and navigating another culture.

Explanation of the choice of Programme Learning Outcomes
Please explain your rationale for choosing these PLOs in a statement that can be used for students (such as in a student handbook). Please include brief reference to:

i) Why the PLOs are considered ambitious or stretching?

To fully meet the PLOs given a student will need to meet the PLOs commensurate with those of a single subject mathematician whilst studying upto two other sciences in Stages 1 & 2. This will ensure that a Nat Sci mathematician has all the expertise of a single subject student in the type of mathematics most appropriate to interdisciplinary science, all backed up by first hand experience of other sciences and how mathematics is used across subject boundaries.

ii) The ways in which these outcomes are distinctive or particularly advantageous to the student:

As stated in the Mathematics single subject programme information: "The outcomes identify six basic areas, which can be summarised as: technique, adaptability, critical thinking, scholarship, communication and digital literacy. When possessed together they give each student the
abilities and understanding to function in any environment where the precision and clarity of mathematical thinking are valuable.". The PLOs above will ensure that a Nat Sci mathematician has all the expertise of a single subject student in the type of mathematics most appropriate to interdisciplinary science, backed up by first hand experience of other sciences in Stages 1 & 2 and how mathematics is used across these subject boundaries.

iii) How the programme learning outcomes develop students' digital literacy and will make appropriate use of technology-enhanced learning (such as lecture recordings, online resources, simulations, online assessment, 'flipped classrooms' etc)?

All students will have the chance to learn programming skills, to use mathematical typesetting software for written projects and for presentations and to use specialist mathematical software in the appropriate modules. Software will be used to compile lab reports & their are various opportunities, not least in the final year project, to develop their skills with using the internet for literature searchs, review. & research. Hence digital literacy is threaded through the degree programme.

iv) How the PLOs support and enhance the students' employability (for example, opportunities for students to apply their learning in a real world setting)?
The programme's employability objectives should be informed by the University's Employability Strategy:

http://www.york.ac.uk/about/departments/support-and-admin/careers/staff/

All the Nat. Sci. programmes have been designed with employability in mind. This is not only as a factor of the design of the programmes themselves, which have had engagement with the University's employability strategy as a given since the early design phases of the programme. But also as a factor of the embedded skills that the contributing departments have built into their modules. Modules which form the bulk of the teaching on this degree programme. For reference, here is the corresponding statement from the Mathematics documentation:
"The PLOs cover a list of skills which are desired by employers: analytical reasoning, confidence with high level mathematics, clarity of communication, flexible thinking, the ability to learn complex ideas quickly and precisely, and digital literacy."
Many of the skills listed in the PLOs are generic and will equip the student with a highly transferrable skill set.

vi) How will students who need additional support for academic and transferable skills be identified and supported by the Department?

Students who need support will generally self identify at admission or early in the Stage 1 and standard University protocols will then be followed. If this isn't the case and a student is identified as needing extra support later in the programme then the student will discuss the matter with their personal supervisor who will advise in accordance with University guidance. Students are assigned a supervisor in one of the contributing departments and have access to a subject facilitator in both contributing departments. The student can approach their supervisor for advice in accordance with University guidelines and seek more specialist advice on a particular discipline from the subject facilitator. Module level issues are handled with the department to which the module belongs and a student can avail themselves off all feedback and quality control mechanisms that the department offers.

vii) How is teaching informed and led by research in the department/ centre/ University?

The lead department in this degree programme is the Mathematics department where most of your classification bearing modules will be taken. This is their statement: "The vast majority of teaching staff are active in research, and through lectures and seminars communicate the influence foundational ideas have on making progress in research. Students also explicitly connect with the principles of research through projects (in Math Skills 2 and the final year dissertation) as well as having the option to choose modules which connect to relatively recent research in their final year. "
You will aslo benefit from early exposure to teaching in two other research active departments.

Stage-level progression

Please complete the table below, to summarise students' progressive development towards the achievement of PLOs, in terms of the characteristics that you expect students to demonstrate at the end of each year. This summary may be particularly helpful to students and the programme team where there is a high proportion of option modules.

Note: it is not expected that a position statement is written for each PLO, but this can be done if preferred (please add information in the 'individual statement' boxes). For a statement that applies across all PLOs in the stage fill in the 'Global statement' box.

Stage 0 (if your programme has a Foundation year, use the toggles to the left to show the hidden rows)

Stage 1

On progression from the first year (Stage 1), students will be able to:	*Developed core learning stratergies for each of the three disciplines studied in Stage 1. Have been introduced to and worked with the core concepts that underpin all three disciplines. Be familiar with the foundational material and practices of each of the three disciplines.*

PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							

Stage 2

On progression from the second year (Stage 2), students will be able to:	*The more focussed Stage 2 will have further developed the knowledge base of the student, giving them more sophisticated tools with which to addess more demanding problems in their two chosen disciplines. Technical facility will be improved by exposure to more advacned concepts.*

PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							

Stage 3

(For Integrated Masters) On progression from the third year (Stage 3), students will be able to:	*A stage 3 student will now be a fully fledged specialist and will have satisfied all the PLOs for the BSc programme. They will be equipped to progress onto a more research focussed final stage.*

PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							

Programme Structure

Module Structure and Summative Assessment Map

Please complete the summary table below which shows the module structure and the pattern of summative assessment through the programme.

'Option modue' can be used in place of a specific named option. If the programme requires students to select option modules from specific lists these lists should be provided in the next section.

From the drop-down select 'S' to indicate the start of the module, 'A' to indicate the timing of each distinct summative assessment point (eg. essay submission/ exam), and 'E' to indicate the end of the module (if the end of the module coincides with the summative assessment select 'EA') . It is not expected that each summative task will be listed where an overall module might be assessed cumulatively (for example weekly problem sheets).

If summative assessment by exams will be scheduled in the summer Common Assessment period (weeks 5-7) a single 'A' can be used within the shaded cells as it is understood that you will not know in which week of the CAP the examination will take place.

Stage 0 (if you have modules for Stage 0, use the toggles to the left to show the hidden rows)

Stage 1

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	MAT00007C	Maths for Sciences I	S										EA																			
20	MAT00007C	Maths for Sciences II												S													EA	A	A			
20	CHE00010C	Chemistry for Natural Sciences I	S					A		A	A		EA																			
20	CHE00012C	Chemistry for Natural Sciences II												S			A	A	A							EA	A	A	A			
20	PHY00022C	Introduction to Thermal & Quantum Physics		S									A									E					A	A	A			
20	PHY00020C	Electromagnetism, Waves & Optics												S												E	A	A	A			

Stage 2

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	MAT00041I	Linear Algebra for Natural Sciences	S																			E	A				A	A	A			
10	MAT00030I	Vector Calculus	S										EA																			
10	MAT00024I	Functions of a Complex Variable											S									E				A	A	A				
30	MAT option	1 of list A [below]	S										A													E	A	A	A			
20	CHE00014I	Chemistry for Natural Sciences 3	S							A		A	EA																			
20	CHE00015I	Chemistry for Natural Sciences 4												S						A			A	A			EA	A	A			
20	CHE00025I	Chemistry for Natural Sciences 5												S													EA	A	A			
20	PHY00039I	Thermodynamics & Quantum Physics																														
20	PHY00002I	Electromagnetism & Optics												S												E	A	A	A			
10	PHY00019I	Physics for Natural Sciences 6: Computational Lab																														
10	PHY00037I	Particle & Nuclear Physics																														
10	PHY00040I	Solid State Physics I																														

Stage 3

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
20	MAT00043H	MMath Group Project [Core, MSci]	S																							E				A		
40	MAT00004H	BSc Final Year Project [Core, BSc]	S									A														E				A		
10	MAT00057H	Modelling with MATLAB [BSc Option]	S									E	A																			
10	MAT00006H	Differential Geometry											S									E					A	A	A			
10	MAT00034H	Cryptography											S									E					A	A	A			
10	MAT00011H	Dynamical Systems	S									E	A																			
10	MAT00048H	Complex and Asymptotic Methods	S									E	A																			

10	MAT00031H	Statistical Pattern Recognition	S									E	A																						
20	MAT00041H	Numerical Analysis	S							A										A		E					A	A	A						
10	MAT00055H	Mathematical Ecology and Epidemiology											S									E					A	A	A						
10	MAT00040H	Partial Differential Equations I	S									E	A																						
10	MAT00054H	Partial Differential Equations II											S									E					A	A	A						
The following four modules are avalible only on the MSci route or for students taking AO1 at stage 2:																																			
10	MAT00053H	Quantum Information											S									E					A	A	A						
10	MAT00024H	Quantum Mechanics I	S									E	A																						
10	MAT00025H	Quantum Mechanics II											S									E					A	A	A						
10	MAT00007H	Electromagnetism & Relativity	S									E	A																						
The following two modules are avalible only on the MSci route or for students taking AO2 at stage 2:																																			
10	MAT00039H	Classical and Biological Fluid Dynamics											S									E					A	A	A						
10	MAT00012H	Fundamentals of Fluid Dynamics	S									E	A																						
The following two modules are avalible only on the MSci route:																																			
10	MAT00030H	Stochastic Processes	S									E	A																						
10	MAT00018H	Survival Analysis	S									E	A																						
Stage 4																																			
Credits	**Module**		**Autumn Term**										**Spring Term**										**Summer Term**												
	Code	**Title**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			
40	MAT00006M	Math Final Year Project [Core, MSci]	S									A														E				A					
10	MAT00052M	Riemannian Geometry											S									E					A	A	A						
10	MAT00046M	General Relativity	S									E	A																						
10	MAT00077M	Advanced General Relativity											S									E					A	A	A						
10	MAT00063M	Hilbert Spaces	S									E	A																						
10	MAT00002M	Quantum Mechanics III	S									E	A																						
10	MAT00048M	Quantum Field Theory											S									E					A	A	A						
10	MAT00066M	Applications of Group Theory to Virology											S									E					A	A	A						
10	MAT00070M	Soft Matter in Physics and Biology	S									E	A																						
10	MAT00021M	C++ Programming with Applications in Finance	S									A										EA					A	A	A						
10	MAT00004M	Directed Learning in Mathematics	S									E	S									E													
The following eight modules are avalible only if students have not taken the module at H level:																																			
10	MAT00007M	Quantum Information											S									E					A	A	A						
10	MAT00053M	Partial Differential Equations I	S									E	A																						
10	MAT00079M	Partial Differential Equations II											S									E					A	A	A						
10	MAT00078M	Complex and Asymptotic Methods	S									E	A																						
10	MAT00080M	Mathematical Ecology and Epidemiology											S									E					A	A	A						
10	MAT00054M	Classical and Biological Fluid Dynamics											S									E					A	A	A						
10	MAT00060M	Modelling with MATLAB	S									EA																							
10	MAT00039M	Survival Analysis	S									E	A																						

Optional module lists

If the programme requires students to select option modules from specific lists these lists should be provided below. If you need more space, use the toggles on the left to reveal ten further hidden rows.

Option List A	Option List B	Option List C	Option List D	Option List E	Option List F	Option List G	Option List H

Applied Maths Option I MAT00036I	Stage 3 of BSci, the Mathematics final year project (core) is required. Students taking AO1 at stage two can choose 40cr Aut & 40Cr Spr of any module EXCEPT: Fundamentals of Fluid Dynamics and Classical and Biological Fluid Dynamics. Students taking AO2 at stage two can choose 40 Cr Aut & 40 Cr Spr of any module EXCEPT: Quantum Mechanics I and II, Quantum Information, and Electromagnetism & Relativity. The MMath group project, Stochastic Processes, and Survival Analysis are NOT available as options.	Stage 3 of MSci, MMath group project (core), as well as Partial Differential Equations I are required. Students taking AO1 at stage two are additonally required to take: Quantum Mechanics I and II, Electromagnetism and Relativity, Differential Geometry, and Complex and Asymptotic methods and can choose 20 Cr Aut & 20 Cr Spr of additonal optional modules. Students taking AO2 at stage two are additonally required to take Dynamical systems and can choose 40 Cr Aut & 40 Cr Spr of additional modules. The BSc project and Modelling in MATLAB are NOT availible as options.	Stage 4 of MSci, all but the Mathematics Final Year Project (core) are options. **Stage 4 provision is subject to change.**				
Applied Maths Option II MAT00037I							

Please note: you need to complete information on all three tabs of this sheet before submitting to the UTC Strategy Working Group.

You are required to submit this information for all undergraduate programme by the 31 July 2016.

Programme Map: Module Contribution to Programme Learning Outcomes

Please complete the summary table below which shows how individual modules contribute to the achievement of programme learning outcomes.

Core modules should be mapped individually. If the programme offers multiple options that contribute to exactly the same PLOs you can group these, providing a statement that articulates how all of these contribute to the achievement of the programme learning outcomes. All modules, both core and optional, should be accounted for in the map.

The table maps the contribution to programme learning outcomes made by each module, in terms of the advance in understanding/ expertise acquired or reinforced in the module, the work by which students achieve this advance and the assessments that test it. This enables the programme rationale to be understood:

· Reading the table vertically illustrates how the programme has been designed to deepen knowledge, concepts and skills progressively. It shows how the progressive achievement of PLOs is supported by formative work and evaluated by summative assessment. In turn this should help students to understand and articulate their development of transferable skills and to relate this to other resources, such as the Employability Tutorial and York Award;

· Reading the table horizontally explains how the experience of a student at a particular time includes a balance of activities appropriate to that stage, through the design of modules.

Note: it is not expected that every module contributes directly to all PLOs, but every module should advance some of them.

Stage	Module		MSci Programme Learning Outcomes							
			PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8

			use, with a high level of confidence and sophistication, the mathematical language and tools that underpin a wide range of research in, and applications to, science, technology and industry	recognise when an unfamiliar problem in any science related discipline is open to mathematical investigation, and be able to formulate their own strategy for the process of such an investigation,	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical context, and develop independently their own ideas using well-founded reasoning,	conduct, both independently and as part of a group of peers, a study of a specialised area of mathematics which takes into account recent mathematical progress. They will be able to compare and synthesise multiple sources to produce this study, and be able to check or complete technical details from these sources independently,	communicate advanced mathematical ideas clearly, in writing and in a presentation, at a level appropriate for the intended audience,	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.	Exploit the synergies between Mathematics and other science based disciplines by using the principles themes, concepts and methodologies of Mathematics as appropriate to a Natural Scientist.	
			BSc Programme Learning Outcomes							
			PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
			use the language of mathematics and confidently identify those problems in mathematics or experimental sciences that can be analysed or resolved by standard mathematical techniques. This includes the ability to apply those techniques successfully in the appropriate context.	recognise when an unfamiliar problem in a scientific discipline is open to mathematical investigation, and be able to adapt and/or synthesise a range of mathematical approaches (including abstraction or numerical approximation) to investigate the problem	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical nature, and be able to justify the mathematical principles they choose for such a critique	conduct a study into a specialised area, by researching material from a variety of sources, and synthesise this material into a well-organized and coherent account.	communicate complex mathematical ideas clearly in writing, at a level appropriate for the intended audience, and also be able to provide an effective summary of these ideas for non-specialists	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.	Exploit the synergies between Mathematics and other science based disciplines by using the principles themes, concepts and methodologies of Mathematics as appropriate to a Natural Scientist.	

Stage 1	Maths for Sciences I	Progress towards PLO	competently use relevant standard mathematical methods	adapt the standard tools to problems slightly outside the standard format	justify the steps and methods used in mathematical arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 1	Maths for Sciences II	Progress towards PLO	competently use relevant standard mathematical methods	adapt the standard tools to problems slightly outside the standard format	justify the steps and methods used in mathematical arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 1	Chemistry for Natural Sciences I	Progress towards PLO		The development of core chemical principles such as thermodynamics require the language of mathematics to describe and develop the relevant theory and then put in to practice in a Chemical setting.					.The development of core chemical principles such as thermodynamics require the language of mathematics to describe and develop the relevant theory and then put in to practice in a Chemical setting.	
		By working on (and if applicable, assessed through)		Examination and assessed workshop					Examination and assessed workshop	
Stage 1	Chemistry for Natural Sciences II	Progress towards PLO		Developing an understanding of core chemical principles of kinetics and thermodynamics requires the language of mathematics to describe and develop the relevant theory and they put the theory into practice.					Developing an understanding of core chemical principles of kinetics and thermodynamics requires the language of mathematics to describe and develop the relevant theory and they put the theory into practice.	
		By working on (and if applicable, assessed through)		Examination and assessed workshop					Examination and assessed workshop	

Stage 1	Introduction to Thermal & Quantum Physics	Progress towards PLO		Solve foundational numerical problems by application of relevant mathematical and physical principles					Gain an understanding of the core importance of quantum mechanics to the science of measurement.	
		By working on (and if applicable, assessed through)		Regular independent assignments (PPQs), small-group problem solving in problem classes, tailored small-group sessions (tutorials), formal examination.					Engaging with teaching materials and links to other modules.	
Stage 1	Electromagnetism, Waves & Optics	Progress towards PLO	Apply problem solving techniques and apply them to weekly problems in an independent way.						Understand that wave mechanics can be used to understand parts of other larger problems beyond those taught explicitly in the course.	

		By working on (and if applicable, assessed through)	Regular independent assignments (PPQs), small-group problem solving in problem classes, examples given in lectures, tailored small-group sessions (tutorials) formal examination.						Engaging with teaching materials.	
Stage 2	Linear Algebra for Natural Sciences	Progress towards PLO	use the standard methods of basic linear algebra and matrix theory, and their theoretical justification through abstract algebra	apply basic linear algebra and matrix theory to a range of unfamiliar situations	prove standard results in abstract linear algebra		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Vector Calculus	Progress towards PLO	use the standard methods of multi-variable differential and integral calculus to work with functions of many variables and vector fields	apply these standard methods to problems which require a level of interpretation to set up the application			present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Functions of a Complex Variable	Progress towards PLO	understand and use the standard methods of complex analysis for functions of one complex variable	apply complex analysis to solve problems in applied real analysis, where their use provides quick and powerful solutions	decide when certain methods from complex analysis can, or cannot, be applied and give a justification for this decision		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination.		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Thermodynamics & Quantum Physics	Progress towards PLO		Apply and adapt a range of basic tools, models, and physical principles to evaluate physics problems of increasing complexity					Appreciate and be aware of the wider applications of thermodynamics and quantum mechanics as topics which underpin much of modern physics.	

		By working on (and if applicable, assessed through)		Regular independent assignments (PPQs), small-group problem solving in problem classes, engaging with lecture material, formal examination.					Engaging with teaching materials	
Stage 2	Electromagnetism & Optics	Progress towards PLO		Apply and adapt a range of basic tools, models, and physical principles to evaluate physics problems of increasing complexity					Appreciate and be aware of the wider applications of electromagnetism and optics as topics which underpin much of modern physics.	
		By working on (and if applicable, assessed through)		Regular independent assignments (PPQs), small-group problem solving in problem classes, engaging with lecture material, formal examination.					Engaging with teaching materials	

Stage 2	Physics for Natural Sciences 6: Computational Lab	Progress towards PLO	Understand the concept of numerical simulation and use idealised simulations to solve physical problems while accepting the limits of numerical simulation.			Work independently on longer and more involved computational investigations to achieve a specified result. This is preparation for BSc projects (BSc students) and Stage 3 advanced computational laboratory.	Keep lab book to an accepted and well-defined standard capturing an accurate and comprehensive account of methodologies and results, and effectively communicate results and ideas via formal reports. This is good preparation for the more extended and independent work in Stage 3, in BSc projects (BSc students) or in advanced computational laboratory (MSci students).			
		By working on (and if applicable, assessed through)	Working individually on numerical computation problems.			Working independently to effectively conduct computational investigations.	Writing a formal scientific report, lab book record-keeping for assessment.			
Stage 2	Particle & Nuclear Physics	Progress towards PLO		Apply and adapt a range of basic tools, models, and physical principles to evaluate physics problems of increasing complexity					Appreciate and be aware of the wider applications of particle & nuclear physics as topics which underpin much of modern physics.	

		By working on (and if applicable, assessed through)		Regular independent assignments (PPQs), small-group problem solving in problem classes, engaging with lecture material, formal examination.					Engaging with teaching materials	
Stage 2	Solid State Physics I	Progress towards PLO		Apply and adapt a range of basic tools, models, and physical principles to evaluate physics problems of increasing complexity					Appreciate and be aware of the wider applications of solid state physics as a topic which underpin much of modern physics.	
		By working on (and if applicable, assessed through)		Regular independent assignments (PPQs), small-group problem solving in problem classes, engaging with lecture material, formal examination.					Engaging with teaching materials	
Stage 2	Applied Maths Option I	Progress towards PLO	competently use relevant mathematical methods in an applied area of science	adapt mathematical tools to solve specific problems in an applied area of science	justify the steps and methods used in mathematical arguments		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Applied Maths Option II	Progress towards PLO	competently use relevant mathematical methods in an applied area of science	adapt mathematical tools to solve specific problems in an applied area of science	justify the steps and methods used in mathematical arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Chem for Nat Sci 3	Progress towards PLO		Developing an understanding of some of advanced chemical principles found in this module will utilise notions of symmetry, group theory and quantum theory to describe and study various advanced topics.					Developing an understanding of some of advanced chemical principles found in this module will utilise notions of symmetry, group theory and quantum theory to describe and study various advanced topics	

		By working on (and if applicable, assessed through)		Examination					Examination	
Stage 2	Chem for Nat Sci 4	Progress towards PLO		Developing an understanding of the advanced chemical principles in this module will utilise many of the mathematical concepts studied in Stages 1 and Stage such as when studying vibrational specroscopy and excited states. Thus putting theorerical mathematics into a more practical setting.					Developing an understanding of the advanced chemical principles in this module will utilise many of the mathematical concepts studied in Stages 1 and Stage such as when studying vibrational specroscopy and excited states. Thus putting theorerical mathematics into a more practical setting.	
		By working on (and if applicable, assessed through)		Examination					Examination	
Stage 2	Chem for Nat Sci 5	Progress towards PLO		Developing an understanding of fundamental chemical principles of solid state chemistry, substitution and elimination and alkenes and alkynes.					Developing an understanding of fundamental chemical principles of solid state chemistry, substitution and elimination and alkenes and alkynes.	

		By working on (and if applicable, assessed through)		Examination					Examination	
Stage 3	**Differential Geometry MAT00006H**	Progress towards PLO	understand and be able to calculate the standard geometric properties of curves and surfaces	decide which geometric properties can be evaluated given different representations of a curve or surface	justify the steps made in differential geometric arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Cryptography MAT00034H**	Progress towards PLO	understand and be able to work with some of the mathematical underpinnings of modern cryptography	apply their current mathematical knowledge to new areas (namely certain cryptographic systems)	follow the reasoning as to why a primality test or a factorisation algorithm works		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Dynamical Systems MAT00011H**	Progress towards PLO	analyse the qualitative features of simple dynamical systems	adapt standard techniques to unfamiliar nonlinear dynamical systems	justify the conclusions of a qualitative analysis of a nonlinear system		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Complex and Asymptotic Methods MAT00048H**	Progress towards PLO	confidently apply tools and techniques of complex analysis in a variety of standard problems, including evaluation of contour integrals and the solution of differential equations	adapt the methods of complex analysis to unfamiliar problems	justify the steps made in application of complex analytic methods		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination.	lecture material and exercises, with the guidance and support of seminars		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Statistical Pattern Recognition MAT00031H**	Progress towards PLO	use statistics to analyse for qualitative patterns in an applied context	tackle unseen problems in models of real-life biological, chemical, or finanical systems by various mathematical approaches	justify the conclusions of a statistical analysis of a problem		present clear and concise solutions to exercises, including the results of mathematical reasoning and the qualitative discussion of the implications and validity of mathematical models			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars and examples classes, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	**Stochastic Processes MAT00030H**	Progress towards PLO	students will be able to formulate and analyse mathematical models that take account of the stochastic (random) fluctuations that are always present in the real world. They will acquire a range of mathematical techniques and approximations that can be used to make analytic predictions from stochastic models	students will be able adapt standard techniques to unfamiliar stochastic dynamical systems	students will be able to justify the arguments behind using stochastic models and recognize the difference with deterministic models of behaviour		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Classical and Biological Fluid Dynamics (H Level) MAT00039H**	Progress towards PLO	apply fluid dynamics techniques to a set of problems in biology	adapt standard applied mathematics techniques to unfamiliar fluid dynamics problems in biology	justify the conclusions of a qualitative analysis of a biological fluid dynamics problem	conduct, independently or in groups, studies on the context or analysis of biological fluid dynamics problems	present clear written or seminar presentations of worked exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback during short presentations in seminars	exercises, with the support of seminars and formative feedback on marked work and presentations			
Stage 3	**Electromagnetism & Relativity MAT00007H**	Progress towards PLO	students will be able to apply vector calculus techniques to Maxwell's equations across a range of standard electromagnetic phenomena	students will be able to apply their theoretical understanding of electromagnetism to a range of phenomena, selecting the appropriate technique and applying it to an unfamiliar problem	students will work through a range of intriguing electromagnetic phenomena, including apparent paradoxes which require clear argument and new theory for their resolution		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	**Fundamentals of Fluid Dynamics MAT00012H**	Progress towards PLO	students will be able to apply basic fluid dynamics techniques to unfamiliar fluid dynamical problems	students will be able to adapt standard techniques to unfamiliar fluid dynamical problems	students will be able to justify the conclusions of a qualitative analysis of a fluid dynamics problem		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Partial Differential Equations I (H Level) MAT00040H Partial Differential Equations II (H Level) MAT00054H**	Progress towards PLO	students will be able to use various techniques for analysing and solving partial differential equations	students will be able to adapt standard techniques to unfamiliar partial differential equations	students will be able to justify the conclusions of a qualitative analysis of a partial differential equation		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	**Mathematical Ecology and Epidemiology MAT00055H**	Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling	justify the assumptions which underlie different models and contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures		present clear written or seminar presentations of worked exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback on marked work and presentations			
Stage 3	**Survival Analysis MAT00018H**	Progress towards PLO	understand and be able to use the standard statistical techniques of survival analysis	apply the methods of survival analysis to unfamiliar data sets	explain the criteria for using the statistical models which apply to survival analysis		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination.	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination.	Lecture material and exercises, with the guidance and support of seminars, and as assessed through examination.		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	**Numerical Analysis MAT00041H**	Progress towards PLO	students will be able to apply numerical approximation techniques to a range of standard mathematical problems	students will be provided with a range of approximation techniques that can be used in unfamiliar application problems	students will be able to justify which particular numerical method is appropriate in a given context, and in which sense the approximation error is small		students will be able to communicate mathematical arguments in Numerical Analysis in writing	implement the numerical methods in practice by means of computer packages (such as Maple or Excel) and/or programming languages (such as Java).		
		By working on (and if applicable, assessed through)	lecture materials, computer practicals, assessed computer-based coursework, as well as being assessed in the examination	lecture materials, computer practicals	lecture materials, computer practicals, written coursework, and as assessed through examination		assessed written coursework	lecture material, computer practicals, coursework		
Stage 3	**Modelling with MATLAB MAT00057H**	Progress towards PLO	students will be able to apply numerical approximation techniques to a range of standard mathematical problems using MATLAB	students will be provided with a range of approximation techniques that can be used in unfamiliar application problems	students will be able to justify which particular MATLAB procedure is appropriate in a given context		students will be able to communicate mathematical arguments resulting from MATLAB in writing	implement the numerical methods in practice by means of the MATLAB computer package.		
		By working on (and if applicable, assessed through)	lecture materials, computer practicals, assessed MATLAB-based coursework, as well as being assessed in the examination	lecture materials, computer practicals	lecture materials, computer practicals, written coursework, and as assessed through examination		assessed written coursework	lecture material, computer practicals, coursework		

Stage 3	**Quantum Mechanics I MAT00024H Quantum Mechanics II MAT00025H**	Progress towards PLO	students will be able to understand how the language of mathematics and mathematical techniques are used to solve standard problems in quantum mechanics	students will be able to tackle unseen problems in quantum mechanics by various mathematical approaches	students will be able to examine critically some applications of quantum mechanical principles		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**Quantum Information MAT00053H**	Progress towards PLO	students will be able to understand how the language of mathematics and mathematical techniques are used to solve standard problems in quantum information	students will be able to tackle unseen problems in quantum information by various mathematical approaches	students will be able to examine critically some applications of quantum informational principles		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	**MMath Group Project MAT00043H**	Progress towards PLO		apply methods from other modules, as appropriate, to the topic of the project	provide a clear critical analysis of the mathematical principles under investigation	make an individual contribution to the study of background material by the group and be able to properly reference sources of information for the written project	present a clear written account of the topic under investigation, as well as a concise summary in poster form	building on the skills developed in Mathematical Skills 1 & 2, prepare a well-structured, technical document involving mathematical typesetting (which may include figures), with proper use of a referencing protocol. They will also be able to prepare a digital master for a poster summarising their project.		

		By working on (and if applicable, assessed through)		the development of the project material, with the guidance of the project supervisor	the background material relevant to the project, with the support of peer discussion and with the guidance of the project supervision meetings	the background for the group project and the written report, with support on proper referencing from the lecture	the written report (approx 30 pages in total), in collaboration with the peer group, and the individually prepared poster. Formative assessment: two short individual assignments during term. Summative assessment: the group project and the poster presentation.	the written report and the poster, with the support of lectures and demonstration classes, and feedback on the two individual assignments during the term.		
Stage 3	**BSc Final Year Project MAT00004H**	Progress towards PLO		adapt and apply the mathematics learned during the degree to some challenging topic outside the BSc degree syllabus	justify the reasoning and/or choice of methods used in the mathematics relevant to the project topic	conduct an independent study into a specialised area of mathematics, by researching material from a variety of sources, and be able to verify independently some of the results described in the literature	communicate advanced mathematical ideas clearly in writing at the final year BSc level, and also be able to present an effective summary of these ideas for non-experts in a presentation	building on the writing and typesetting skills developed in earlier years, prepare a long, well-structured, technical document involving mathematical typesetting (which may include figures), with proper use of a referencing protocol. They will also be able to prepare slides for a short presentation.	An independently researched, year long project in an area of mathematics that is applied in nature.	

		By working on (and if applicable, assessed through)		material found in the literature, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation (30-40 pages) and the presentation talk (10 minutes), with the support of the project supervisor, lectures and demonstration on writing and presenting mathematics, as assessed by the writing assignments, the dissertation and the presentation talk.	preliminary assignments which develop an appreciation of layout for documents and slides, the use of structure, the inclusion of figures. This is supported by practical classes, with feedback on assignments, and assessed through assignments and the presentation.	A presentational aspect to the project will be built in on a project day, where students will be tasked to present the findings of their research to their peers across their cohort. To enable students from different disciplines to understand their presentation, a student will need to appreciate th inter-disciplinary aspects of their subject and be able to effectively communicate to a general audience.	
Stage 4	**Riemannian Geometry MAT00052M**	Progress towards PLO	work with the standard tools required for understanding the geometry of Riemannian manifolds	apply these ideas to the analysis of unfamiliar concrete examples	produce their own lines of reasoning to prove statements, both general and specific, about the geometry of Riemannian manifolds		present clear written or seminar presentations of worked exercises, and group work within seminars			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback on marked work and presentations, and interaction with peers			
Stage 4	**Classical & Biological Fluid Dynamics MAT00054M**	Progress towards PLO	apply high level fluid dynamics techniques to a set of problems in biology	adapt standard applied mathematics techniques to unfamiliar fluid dynamics problems in biology	justify the conclusions of a qualitative analysis of a biological fluid dynamics problem	conduct, independently or in groups, studies on the context or analysis of biological fluid dynamics problems	present clear written or seminar presentations of worked exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback during short presentations in seminars	exercises, with the support of seminars and formative feedback on marked work and presentations			
Stage 4	**General Relativity MAT00046M**	Progress towards PLO	perform calculations in Einstein's theory of gravity using the framework of curved space-time	solve unfamiliar problems in General Relativity using the mathematical formulation of Einstein's theory	justify on both mathematical and physical grounds the conceptual framework of General Relativity		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 4	**Partial Differential Equations I MAT00053M**	Progress towards PLO	use, with a high level of sophistication, a number of standard techniques for analysing and solving linear partial differential equations	adapt standard techniques to unfamiliar partial differential equations	justify the conclusions of a qualitative analysis of a partial differential equation		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 4	**Mathematical Ecology & Epidemiology MAT00080M**	Progress towards PLO	use a range of mathematical techniques to model biological systems	adapt existing techniques to novel situations	discuss and investigate standard problems and research papers		provide clear descriptions of how mathematical modules provide insight into the behaviour of biological systems			
		By working on (and if applicable, assessed through)	standard problems and research papers during supporting seminars	problems emerging from standard problems and research papers during supporting seminars	problems emerging from standard problems and research papers during supporting seminars		coursework assessment, with the support of seminars			
Stage 4	**Modelling with MATLAB MAT00060M**	Progress towards PLO	write computer code to enable the numerical investigation of mathematical models in the life sciences	interpret empirical data in the context of some appropriate mathematical models	justify the mathematical models being used on the grounds of sound scientific and mathematical principles	relate the techniques to up-to-date research papers	write independent reports summarising key outputs clearly and concisely	be competent with the fundamentals of programming in MATLAB (a mathematical programming language for computation and visualization).		
		By working on (and if applicable, assessed through)	lectures and practical sessions, with feedback on formative coursework, and as assessed by coursework.	coursework, with the support of practical sessions	lectures and formative coursework, and as assessed by summative coursework.	lectures and coursework	coursework, with the support of lectures and feedback from marked work	lectures and practical sessions, and as assessed through coursework		

State 4	**Partial Differential Equations II MAT00053M**	Progress towards PLO	use basic numerical methods to model solutions to partial differential equations, and estimate the errors inherent in such methods	apply these methods to unfamiliar examples	justify which numerical methods are appropriate for a given problem, and how to control the errors involved		present clear and concise solutions to exercises and coursework	write code in MATLAB in the context of the numerical solution of PDEs		
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of practical classes, and through feedback on marked work, and as assessed through examination		exercises and coursework. With the support of practical classes	exercises and coursework. With the support of practical classes		
Stage 4	**Quantum Information MAT00007M**	Progress towards PLO	understand and use the language of quantum information theory	recognise when an information-theoretic problem may have a quantum advantage and understand the techniques that may solve them	developing lines of reasoning using the principles of quantum theory		explain clearly key ideas of quantum information theory and advantages of quantum protocols over classical			
		By working on (and if applicable, assessed through)	exercises, reading course materials and discussions in lectures	exercises, reading course materials and discussions in lectures	presentation and communication of ideas in solutions to exercises		presentation and communication of ideas in solutions to exercises and answering questions in lectures			

Stage 4	**Quantum Mechanics III MAT00002M Quantum Field Theory MAT00048M**	Progress towards PLO	apply, with a high level of competence, techniques of quantum theory to various systems originating in atomic or high energy physics	understand how general formalism of quantum theory can be adapted to physical systems and be able to solve unfamiliar problems	critically analyse the framework of quantum theory for consistency and analyse and justify one's own reasoning		present clear and concise solutions to exercises on advanced quantum theory			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	working through the module material and presentation and communication of ideas in solutions to exercises		exercises, with the support of seminars and formative feedback through marked work			
Stage 4	**Applications of Group Theory to Virology MAT00066M Biological and Soft Matter MAT00070M**	Progress towards PLO	use a range of mathematical techniques to mathematically model phenomena from the biological sciences	adapt and apply the methods discussed in lectures to other problems in biological or ecological modelling	justify the assumptions which underlie different models	contribute to a group discussion on the uses and meaning of the mathematical models presented in lectures	present clear written or seminar presentations of worked exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises and seminars	exercises, with the support of seminars and formative feedback on marked work and presentations			

Stage 4	**C++ Programming with Applications in Finance MAT00021M**	Progress towards PLO	write C++ code which can be used for standard applications in mathematical finance	apply and adapt code to an unfamiliar practical problem in the setting of finance	critically analyse code for correctness and suitability for an application in finance		write clear and coherent C++ code and an accompanying report on its use and purpose	write and compile C++ code in the context of financial applications		
		By working on (and if applicable, assessed through)	lectures, practical classes, exercises and as assessed by coursework and class tests	exercises and coursework	practical classes, exercises and coursework, with feedback from marked work		exercises and coursework, with the support of practical classes and feedback from marked work	exercises and coursework, with the support of practical classes and feedback from marked work		
Stage 4	**Directed Learning in Mathematics MAT00004M**	Progress towards PLO	understand and be able to use methods relevant to the area of specialism of the DLM		critically analyse the literature to obtain a clear understanding of the topic under discussion		write clear and concise work as required by the assessment of the DLM			
		By working on (and if applicable, assessed through)	recommend reading and seminars		recommend reading and seminars		coursework, with the support of the seminars			

Stage 4	**MMath Final Year Project MAT00006M**	Progress towards PLO		adapt and apply the mathematics learned during the degree to some challenging topic outside the MMath degree syllabus	justify the reasoning and/or choice of methods used in the mathematics relevant to the project topic	conduct an independent study into a specialised area of mathematics, by researching material from a variety of sources, and be able to verify independently some of the results described in the literature	communicate advanced mathematical ideas clearly in writing at the final year BSc level, and also be able to present an effective summary of these ideas for non-experts in a presentation	building on the writing and typesetting skills developed in earlier years, prepare a long, well-structured, technical document involving mathematical typesetting (which may include figures), with proper use of a referencing protocol. They will also be able to prepare slides for a short presentation.	An independently researched, year long project in an area of mathematics that is applied in nature.	

		By working on (and if applicable, assessed through)		material found in the literature, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation (30-40 pages) and the presentation talk (10 minutes), with the support of the project supervisor, lectures and demonstration on writing and presenting mathematics, as assessed by the writing assignments, the dissertation and the presentation talk.	preliminary assignments which develop an appreciation of layout for documents and slides, the use of structure, the inclusion of figures. This is supported by practical classes, with feedback on assignments, and assessed through assignments and the presentation.	A presentational aspect to the project will be built in on a project day, where students will be tasked to present the findings of their research to their peers across their cohort. To enable students from different disciplines to understand their presentation, a student will need to appreciate th inter-disciplinary aspects of their subject and be able to effectively communicate to a general audience.	
Stage 4	**Hilbert Space MAT00063M**	Progress towards PLO	work with the standard tools and results concerning Hilbert spaces and operators between them	apply these methods to unfamiliar problems on abstract or concrete Hilbert spaces	produce their own lines of reasoning to prove statments aobut Hilbert spaces and their operators		present clear written or seminar presentations of worked exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback on marked work and presentations			
Stage 4	**Survival Analysis MAT00039M**	Progress towards PLO	understand and be able to use to a high level of competence the statistical techniques of survival analysis	confidently apply the methods of survival analysis to unfamiliar data sets	justify the criteria for using the statistical models which apply to survival analysis		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination	exercises, with the guidance and support of practical sessions, and through feedback on marked work	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination		exercises, with the support of seminars and formative feedback through marked work			

Programme Map: Module Contribution to Programme Learning Outcomes

The information provided in this section should make clear why the students are doing the key activities of the programme, in terms of reaching the PLOs. You should use this section to provide commentary on the programme map and how current practice effectively propels student learning. Please indicate any changes that you plan to make to the programme linked to the pedagogic principles.

This section should capture reflections on the programmes and areas for development linked to the principles of the York pedagogy. Please provide an explanation of the programme and assessment design with reference to future enhancements aligned with the pedagogic principles.

Contact with staff
Please explain how the programme's design maximises the value of students' contact time with staff (which may be face-to-face, virtual, synchronous or asynchronous), including through the use of technology-enhanced learning. An example might be giving students resources for their independent study which then enables a class to be more interactive with a greater impact on learning.

You should include:

i. An explanation of how contact with staff in the future programme will be designed to propel student learning

The vast majority of the programme is made up of modules from the Department of Mathematics. Therefore the relevant statements made in that department's respective submissions apply here. Note is also made to refer to the Chemistry and Physics YP single subject documentation due to the 1/3, 1/2 splits in Stages 1 and 2.

ii. Changes to the existing programme that will be explored to affect this change; make references to the map to include module level change.

Significant changes have already been made to the structure of the programme due to the early rollout of the YP in Mathematics & Physics. There will also be changes due to Chemistry changing its provision. The net effect has been a more streamlined programme with less optionality in Stage 2. But a more focussed programme overall. This reduced optionality is consistent across all Nat Sci programmes. All courses, this one included, are reviewed annually and feedback will be given to all contributing departments. Any further changes that may be necessary will naturally arise during this process of review.

The pathway leader for CMP has reviewed the content of the Stage 2 Maths for Sciences III module to streamline the material and reduce overlap with the Stage 1 modules. This will take effect in 2017/18.

Maths is currently reviewing its entire Stage 3 & 4 provision. Disucssions are ongoing and will be communicated to both BoS once plans have been finalised.

Students' independent study and formative work

Please outline key features of how independent study and formative work has been designed to support the progressive achievement of the programme learning outcomes. (For example, the use of online resources, which may also incorporate formative feedback; opportunities for further learning from work-based placements).

You should include:

i. An explanation of how students' independent study and formative work has been designed in the future programme to propel student learning?

Again, we refer to the corresponding statements in the chemistry, mathematics and physics enhancement plans for the reasons stated above.

ii. Changes to the existing programme to affect this change; make reference to the programme map to indicate module level change

Changes due to the mathematics roll out of the YP are already in place. Further changes will follow as Maths is currently looking at its Stage 3 & 4 provision which makes up the bulk of this degree programme. Any changes will be phased in as and when the happen in the single subject degrees. Reference is made to the corresponding statements in the chemistry, mathematics and physics enhancement plans.

Due to the nature of all our specialisation programmes and the fact that the learning and teaching in Stages 1 & 2 is spread across multiple departments, there may be bottlenecks for the students in terms of assessment. Currently this is handled on a report to the BoS basis and then escalated outwards after a BoS meeting to the Departments. This is a challenge for Natural Sciences and and a definite enhancement to the programmes will be some way of monitoring and controlling these bottlenecks. Currently the YP doesn't help as its level of detail is module assessment and that we have more control over. It's the intra-module assessment. We will carry on investigating ways in which we can manage this issue effectively for our students.

One thing that we have not yet being able to do is use any NSS returns to identify issues or good practice as we have yet to have a graduating cohort. Once this data comes in then we will of course incorporate the outcomes into our annual review processes.

(c) Summative Assessment

Please outline how summative assessment within and across modules has been designed to support and evidence the progressive achievement of the programme learning outcomes. (For example, the use of different assessment methods at the 'introduction' stage compared to those used to evaluate deeper learning through the application of skills and knowledge later in the programme).

You should include:

i. An explanation of how formative and summative assessment has been designed in the future programme to propel student learning?

As in Item 5; Nat Sci honours the pedagogical practices of our contributing departments whenever possible and this is certainly the case in summative assessment. The vast majority of the programme is built on modules from the single subject diet and the assessment modes used are judged best to assess the various learning outcomes on these modules.

ii. Changes to the existing programme to affect this change; make reference to the programme map to indicate module level change

As for item 12.

The final year project is a major component of all our degrees and is a chance for our students to show not only their skills and ability in a specialist, but also to work in their specialism on a project that is interdisciplinary. Indeed this is seen at the most natural place to assess any PLOs which emphasise interdisciplinarity. The full process of running projects is currently under review and any changes/improvements will be incorporated into the programmes.

We need to figure out how to faithfully capture the interdisciplinarity of the programme when a lot of it isn't assessed e.g.
(a) the intentional juxtaposition of modules from different departments that cover complementary/similar topics
(b) Natural Sciences hour
The latter is especially important as its a unique feature of the Nat Sci programmes.

Support with implementing programme enhancements

Support services will be able to provide guidance on enhancing programmes for example changing assessment and feedback practice, developing students' digital literacy capabilities and technology enhanced learning, employability etc. Please indicate in the space below if you would like additional guidance to implement you enhancements and what support you would require. For more information on the types of support that is available across the University please see the website:

https://www.york.ac.uk/staff/teaching/support/

Infrastructure: we look forward to the creation of a fully-functional programme & module catalogue which will enable:

- the efficient sharing of information between departments (& the ASO) e.g. module changes
- the shared usage of information for a variety of purposes (e.g. programme specs, admissions materials, student handbooks, website, ...)
- identification of issues like assessment bottlenecks & student workload

Nat Sci would like to give a particular note of thanks to David Gent, Cecillia Lowe, Katy Mann Benn & colleagues for their support when compiling this documentation and undergoing the process of making our programmes YP compliant. Their input has been invaluable.