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Training Schools PROPOSAL

Document Status: With Owner

EPSRC Reference:

Training Schools (Open Call)

Organisation where the Grant would be held

Organisation	University of Edinburgh	Research Organisation Reference:	SMSTC April 2011
Division or Department	Sch of Mathematics		

Project Title [up to 150 chars]

Scottish Mathematical Sciences Training Centre -- Follow-on funding for a Taught Course Centre for UK PhD students in the Mathematical Sciences

Start Date and Duration

a. Proposed start date

01 October 2011

b. Duration of the grant (months)

60

Applicants

Role	Name	Organisation	Division or Department
Principal Investigator	Professor Anthony Carbery	University of Edinburgh	Sch of Mathematics
Co-Investigator	Dr Penny J Davies	University of Strathclyde	Mathematics and Statistics
Co-Investigator	Dr Pieter Blue	University of Edinburgh	Sch of Mathematics
Co-Investigator	Professor Jack Carr	Heriot-Watt University	S of Mathematical and Computer Sciences
Co-Investigator	Professor Mark Chaplain	University of Dundee	Mathematics
Co-Investigator	Dr Alastair Craw	University of Glasgow	School of Mathematics & Statistics
Co-Investigator	Professor Meinolf Geck	University of Aberdeen	Mathematical Sciences
Co-Investigator	Professor Desmond Higham	University of Strathclyde	Mathematics and Statistics
Co-Investigator	Professor Alan William Hood	University of St Andrews	Mathematics and Statistics
Co-Investigator	Dr Radha Kessar	University of Aberdeen	Mathematical Sciences
Co-Investigator	Dr Ruth King	University of St Andrews	Mathematics and Statistics
Co-Investigator	Dr Rachel Norman	University of Stirling	Computing Science and Mathematics
Co-Investigator	Professor Richard Joseph Szabo	Heriot-Watt University	S of Mathematical and Computer Sciences
Co-Investigator	Professor James Wright	University of Edinburgh	Sch of Mathematics
Co-Investigator	Dr Stan Zachary	Heriot-Watt University	S of Mathematical and Computer Sciences

Objectives

List the main objectives of the proposed research [up to 4000 chars]

The main objective of the proposal is to permit the Scottish Mathematical Sciences Training Centre (SMSTC) to continue to offer broadening training to first year students in the mathematical sciences with the ultimate goal of bringing their experience into

line with that offered in competitor countries and of making the recipient of a UK PhD in the mathematical sciences more competitive in the academic employment market.

Extensive course development during the first funded year of the current EPSRC

grant for SMSTC means that we have a comprehensive portfolio of teaching material.

Although stream content and assessment has been revised in response to staff and student comments since SMSTC became operational we plan to hold a more substantial review of the entire academic provision should we be awarded follow-on funding.

We are keen to keep the spread of participation of academics across the consortium in the SMSTC's activities as broad as possible. A continual refresh of the staff involved in management and course delivery will be even more important as the SMSTC enters its second five-year phase and is a key aspect of our development. The entire operation will continue to depend crucially on the contributions of the SMSTC universities in terms of academic staff time for course delivery and management, technical expertise and provision of accommodation for the VC lectures - we estimate the value of this contribution (i.e. the cost borne by contributing departments) to be at least £150k per year. The day-to-day administration of the SMSTC also requires significant on-going support (0.45 FTE of an administrator's time). The face-to-face residential symposia also entail a substantial cost to the operation. These two components (administrative support and symposium costs) comprise a large proportion of the funding we are applying for.

We shall continue to make the training we offer available to a wide range of potential customers outside the consortium and to expand this base as an aid to future sustainability. We will also continue to encourage the development of Scottish, UK and international seminars and advanced informal courses to be delivered to a wider audience using the SMSTC video-conferencing equipment.

Summary

Describe the proposed research in simple terms in a way that could be publicised to a general audience [up to 4000 chars]

Since the autumn of 2007 when the SMSTC became fully operational, it has offered a broad range of high-quality courses designed for first year PhD students in the mathematical sciences. The primary aim of these courses has been to broaden students' mathematical perspective with the ultimate goal of bringing their experience into line with that offered in competitor countries and of making the recipient of a UK PhD in the mathematical sciences more competitive in the academic employment market.

The SMSTC provides eight core streams of material, each taught in 20 two-hour lectures (over two semesters) delivered "live" by dedicated video-conferencing (VC). Comprehensive printed notes are made available for students to download and read about a week before each lecture from www.smstc.ac.uk, the SMSTC wiki-based website. There is also local tutorial support provided by a student's home department, and there are two short residential symposia at which students have the opportunity to meet each other and the teaching teams. Beginning PhD students have normally been expected to take three streams, and to spend about 75% of their time studying the course material during the first six months of their PhD programme. This means that students are also able to begin working with their supervisor from the start of their PhD studies.

The SMSTC also provides generic skills training in key areas which support research, such as using bibliographic databases, report writing and giving talks.

SMSTC is a cooperative venture (consortium) of mathematical sciences departments at seven Scottish universities, (Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St Andrews and Strathclyde, together with Stirling as an associate member) and as such draws on the active participation of academic staff from these departments in both its management and operational functions. The management of the SMSTC is undertaken by a Director and Deputy Director together with an Academic Steering and Management Group (ASMG) which contains representatives of each participating department and is constituted so as to be able to give a broad academic overview of the areas of mathematical sciences involved. It also contains external representatives in order to provide an independent perspective and advice. As well as being important for quality assurance, this aids in the dissemination of good practice throughout the UK.

Each core stream that we offer is delivered by a team of academics drawn from across the universities and is headed up by a Stream Leader. The Stream Leaders projected to be in post for 2011/12 are also named as co-Investigators on the project. They are all eminent researchers in their respective fields and are capable organisers who have proved their abilities in inspiring their team members to actively contribute to a coherent programme of instruction within the stream. They oversee the operation of each stream and coordinate the teaching team, ensure that appropriate assessment takes place and prepare a brief stream report for the ASMG.

Day-to-day administration for SMSTC is undertaken by the International Centre for Mathematical Sciences (ICMS) which is a joint institute of Edinburgh and Heriot-Watt universities established in 1990. Since then ICMS has organised over 200 meetings and has an established reputation in the UK and internationally for organising regular high-quality scientific events.

Academic Beneficiaries

Describe who will benefit from the research [up to 4000 chars].

The main academic beneficiaries will be the 90 or so PhD students in the Mathematical Sciences in consortium institutions who will partake of the courses we offer each year.

SMSTC's core aim is to provide high quality broadening training in the mathematical sciences to first year PhD students, equipping them with skills in a range of mathematical and statistical techniques. This will enable students to recognise and exploit connections between different branches of mathematical sciences and thus enhance their ability to do research at a high level. There is an acknowledged problem in the people pipeline within UK mathematical sciences, with UK PhD students finding it hard to compete with those whose PhD programmes involve a substantial taught component. The goal of SMSTC is to broaden our students' mathematical perspective to bring their experience more into line with international norms, so they are more competitive in the academic employment market, and to enhance the PhD programme by teaching our students a broad range of mathematical and statistical ideas and techniques. This will equip them with the necessary background knowledge to make scientific advances in their research during (and after) the PhD.

SMSTC also provides generic skills training in key areas which support research, such as using bibliographic databases, report writing and giving talks.

We shall continue to make the training we offer available to a wide range of potential customers outside the consortium. We have had some success in attracting interest in courses and materials from individuals and organisations outside the SMSTC consortium (from NUI Galway as well as students in science and engineering departments in consortium universities). Up until now we have mainly publicised SMSTC to mathematical scientists, but we plan to actively advertise our portfolio to departments within our universities. Indeed, SMSTC was advertised extensively within the mathematical science community during its first funded period (with articles in the newsletters of the European and London Mathematical Societies, the Institute of Mathematics and its Applications and MSOR), and now that it is well-established it would be timely to advertise more heavily to science and engineering departments within our universities, especially those whose research involves high-level mathematics or statistics. The Statistics stream will be attractive for students from bioscience and management science, and the applied mathematics streams for students from petroleum engineering.

We will also continue to encourage the development of Scottish, UK and international seminars and advanced informal courses to be delivered to a wider audience using the SMSTC video-conferencing equipment, so the potential academic benefitees here are unlimited.

Impact Summary

Impact Summary (please refer to the help for guidance on what to consider when completing this section) [up to 4000 chars]

Since the aim of the TCC initiative is to provide core student training, it is clear that the main impact of this proposal will be in the people and knowledge categories. But because a large proportion of PhD graduates are employed outwith academia, there will also be significant impact on society and the economy.

People

SMSTC's core aim is to provide high quality broadening training in the mathematical sciences to first year PhD students, equipping them with skills in a range of mathematical and statistical techniques. This should enable students to recognise and exploit connections between different branches of mathematical sciences and thus enhance their ability to do research at a high level. SMSTC also provides generic skills training in key areas which support research, such as using bibliographic databases, report writing and giving talks.

There is an acknowledged problem in the people pipeline within UK mathematical sciences, with UK PhD students finding it hard to compete with those whose PhD programmes involve a substantial taught component. The recent International Review of Mathematical Sciences notes the low proportion of UK-trained mathematical scientists amongst new academic appointments and says: the panel regards this fragility as a serious potential risk to the UK's future international standing. The goal of SMSTC is to broaden our students' mathematical perspective to bring their experience more into line with international norms, so they are more competitive in the academic employment market.

Knowledge

The fundamental aim of SMSTC is to enhance the PhD programme by teaching our students a broad range of mathematical and statistical ideas and techniques. This will equip them with the necessary background knowledge to make scientific advances in their research during (and after) the PhD.

Economy and society

A large proportion of mathematical sciences PhD students enter employment outwith academia. They are highly prized by employers, as shown for example by starting salaries. A broader mathematical knowledge as provided by SMSTC will undoubtedly increase the value of mathematical sciences postgraduates to the economy and society.

Summary of Resources Required for Project

Financial resources

Fund heading	Full economic Cost	EPSRC contribution	% EPSRC contribution
Travel & Subsistence	36825.00	36825.00	100
Other Costs	113175.00	113175.00	100
Sub-total	150000.00	150000.00	
Total	150000.00	150000.00	

Other Support

Details of support sought or received from any other source for this or other research in the same field.

Other support is not relevant to this application.

Related Proposals

Proposal is related to a previous proposal to EPSRC

Reference Number	How related?
EP/E502083/1	Continuation

Previous Proposals

Enter the EPSRC reference numbers of any support sought or received from EPSRC in the past five years.	
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Travel and Subsistence

Destination and purpose		Total £
Within UK	Staff travel and subsistence (symposia and ASMG)	17250
Within UK	Student accommodation and subsistence (symposia)	19575
Total £		36825

Other Directly Incurred Costs

Description	Total £
Coordination costs (excluding travel and subsistence)	99175
Course development	14000
Total £	113175



10th May 2011

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Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The University of Edinburgh is pleased to submit a proposal for the Maths TCC Call for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC).

The proposal has been approved through the correct approval processes of the University of Edinburgh namely Edinburgh Research and Innovation Ltd.

Yours sincerely

Michelle Swain

Michelle Swain
Research Administrator

Scottish Mathematical Sciences Training Centre (SMSTC)

Follow-on funding for a TCC for UK PhD students in the Mathematical Sciences

A Track Record

SMSTC has offered a broad range of high-quality courses designed for first year PhD students in the mathematical sciences since autumn 2007. The primary aim is to broaden students' mathematical perspective with the ultimate goal of bringing their experience into line with that offered in competitor countries and of making the recipient of a UK PhD in the mathematical sciences more competitive in the academic employment market. Course content has evolved in the light of staff and student evaluations.

The SMSTC provides eight core streams of material, each taught in 20 two-hour lectures (over two semesters) delivered "live" by dedicated video-conferencing (VC). Comprehensive printed notes are made available for students to download and read from www.smstc.ac.uk, the SMSTC wiki-based website. Tutorial support is provided by a student's home department, and there are two short residential symposia at which students have the opportunity to meet each other and the teaching teams. Beginning PhD students have normally been expected to take three streams, and to spend about 75% of their time studying the course material during the first six months of their PhD programme (they begin working with their supervisor from the start of their PhD studies).

SMSTC is a cooperative venture (consortium) of mathematical sciences departments at seven Scottish universities, (Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St Andrews and Strathclyde, together with Stirling as an associate member) and as such draws on the active participation of academic staff from these departments in both its management and operational functions. Management is undertaken by a **Director** and **Deputy Director** together with an **Academic Steering and Management Group** (ASMG) which contains representatives of each participating department and is constituted so as to be able to give a broad academic overview of the areas of mathematical sciences involved. It also contains external representatives in order to provide an independent perspective and advice. The academic members of the ASMG from consortium departments are co-Investigators on this project.

ASMG members from consortium departments

- Director of the SMSTC and Principal Investigator: Anthony Carbery, Edinburgh (analysis)
- Deputy Director of the SMSTC: Penny Davies, Strathclyde (numerical analysis)
- Pieter Blue, Edinburgh (analysis)
- Mark Chaplain, Dundee (mathematical biology)
- Alastair Craw, Glasgow (algebra, geometry & topology)
- Des Higham, Strathclyde (numerical analysis and complexity)
- Alan Hood, St Andrews (magnetohydrodynamics)
- Radha Kessar, Aberdeen (algebra)
- Ruth King, St Andrews (statistics)
- Richard Szabo, Heriot-Watt (geometry, topology and mathematical physics)
- Ronnie Wallace, Strathclyde (computer officer)

Carbery has been Director of the SMSTC since its inception and has spearheaded all aspects of its development since then. He has wide experience of managing other projects and grants – e.g. the EPSRC Science & Innovation CANPDE award and several large EU grants held in the University of Edinburgh. He is the Colin Maclaurin Professor of Mathematics at Edinburgh. **Davies** has been Deputy Director of the SMSTC again since its inception and has been largely responsible for setting up the organisational structure. She also has a great deal of experience of managing mathematical activities and is the current President of the Edinburgh Mathematical Society (EMS). **Blue** is a recent appointee to the University of Edinburgh and has taken over responsibility for student liaison. The remaining academic members of the ASMG are all senior academics in their institutions and are without specific portfolios. **Mark Chaplain** is Professor of Applied Mathematics

and Head of Department and holds an ERC Advanced Investigator award. **Alastair Crow** is on the editorial boards for both the London Mathematical Society and the Glasgow Mathematical Journal. **Des Higham** holds the 1966 Chair of Numerical Analysis, is on numerous editorial boards and is the co-author of several books. **Alan Hood** is a Professor of Applied Mathematics and former Head of Department. **Radha Kessar** is a recent LMS Berwick prizewinner. **Ruth King** is on the committee of the EPSRC-funded National Centre for Statistical Ecology and the editorial boards of two statistical journals. **Richard Szabo** is a Professor of Mathematical Physics and convenes the departmental Research Committee. ASMG members typically serve first terms of 3–4 years (the initial terms were staggered so the original members were not all due to finish at the same time), with a possibility of renewal for a shorter second term. About half of the current members from consortium departments have been on the ASMG since its inception, with the other half coming on within the past 18 months. We believe that this approach provides both stability and the inflow of new ideas and a fresh perspective. The ASMG is augmented by four **external members**: Vivienne Blackstone (EPSRC), Francis Clarke (Swansea), Chris Glasbey (BIOSS) and Andy Wathen (Oxford). As well as being important for quality assurance, this aids in the dissemination of good practice throughout the UK.

Each core stream that we offer is delivered by a team of academics drawn from across the universities and is headed up by a **Stream Leader** (SL). The SLs projected to be in post for 2011/12 are also named as co-Investigators on the project, and are listed below. They are all eminent researchers in their respective fields and are capable organisers who have proved their abilities in inspiring their team members to actively contribute to a coherent programme of instruction within the stream. They oversee the operation of each stream and coordinate the teaching team, ensure that appropriate assessment takes place and prepare a brief stream report for the ASMG. Four of the current SLs have held the role since SMSTC started, and managed transitions are encouraged. The teaching teams have also changed over the four years of SMSTC's operation (usually with an incremental change in personnel each year), and a significant number of staff from Scottish universities have been involved in SMSTC teaching.

Stream Leaders 2011/12

- Algebra: Meinolf Geck (Aberdeen)
- Geometry and Topology: Alastair Crow (Glasgow)
- Pure Analysis: Jim Wright (Edinburgh)
- Applied Analysis and PDEs: Jack Carr (Heriot–Watt)
- Applied Mathematics Methods: Alan Hood (St Andrews)
- Mathematical Models: Rachel Norman (Stirling)
- Probability: Stan Zachary (Heriot–Watt)
- Statistics: Ruth King (St Andrews)

Day-to-day administration for SMSTC is undertaken by the **International Centre for Mathematical Sciences** (ICMS) which is a joint institute of Edinburgh and Heriot-Watt universities established in 1990. Since then ICMS has organised over 200 meetings and has an established reputation in the UK and internationally for organising regular high-quality scientific events.

The TCCs were reviewed for EPSRC in the summer of 2010 by DTZ¹, and it is fair to say that this review paints a very positive picture of the achievements of SMSTC. Some 90 or so students have benefitted from the training provided by the SMSTC in each of its four sessions to date, although as the DTZ report notes, it is too early to judge the success of the venture in terms of employment in the academic job market as the first tranche of students is only now graduating. The activities of the SMSTC have also been praised in feedback both by the RAE 2008 panels and by the 2010 International Review of Mathematical Sciences.

¹See www.epsrc.ac.uk/pubs/reports/Pages/maths.aspx for the main report and http://www.smstc.ac.uk/wiki/index.php?title=Management_Section for the SMSTC annexe.

B The SMSTC and its future direction

Future plans

The main aim of the SMSTC over the next five years is to continue to offer high-quality broadening training in the mathematical sciences. Extensive course development during the first funded year of the current EPSRC grant for SMSTC means that we have a comprehensive portfolio of teaching material. Although stream content and assessment has been revised in response to staff and student comments since SMSTC became operational (stream review is a standing item at the May ASMG meeting), we plan to hold a fuller academic review should we be awarded follow-on funding.

We are keen to keep the spread of participation of academics in SMSTC's activities as broad as possible. A continual refresh of the staff involved in management and course delivery is a key aspect of our development. The entire operation will continue to depend crucially on the contributions of the SMSTC universities in terms of academic staff time for course delivery and management, technical expertise and provision of accommodation for the VC lectures – we estimate the value of this contribution (i.e. the cost borne by contributing departments) to be at least £150k per year. The day-to-day administration of the SMSTC also requires significant on-going support (0.45 FTE of an administrator's time). The face-to-face residential symposia (singled out by DTZ as an especially valuable component of the students' experience when the primary medium of instruction is remote, as in the SMSTC) also entail a substantial cost to the operation. These two components (administrative support and symposium costs) comprise a large proportion of the funding we are applying for.

We shall continue to make the training we offer available to a wide range of people outside the consortium and to expand this base as an aid to future sustainability. We will also continue to encourage the development of Scottish, UK and international seminars and advanced informal courses to be delivered to a wider audience using the SMSTC video-conferencing equipment. Constructive engagement with the other TCCs is also very important in order to share ideas and best practice, and while this engagement has been taking place informally over the last five years, SMSTC is enthusiastic about participating in an annual TCC Directors' forum (likely to be held in conjunction with the annual meeting of the LTCC Advisory Board). We will continue to contribute to developments in the education of PhD students in the Mathematical Sciences on a broader stage, and the consortium departments are keen to play a role in any future Doctoral Training Centre type activity should such a possibility arise.

We have kept good records throughout SMSTC's operation (on management, course provision, student registration, staff and student evaluation, assessment grades), and shall continue to do this.

Courses offered and their delivery

The aim is to provide a broad training in fundamental elements of mathematics and statistics, delivered in eight core streams and designed to complement more specialised courses and seminars already available in institutions. Each stream is self-contained, but connections and links between them are built-in and emphasised. Each stream is formally reviewed at the May ASMG meeting (the meeting papers include staff and student evaluation comments and a report from each stream leader), and the content and assessment has evolved in response to this. However we believe that it would be timely to hold a fuller **academic review** of the whole SMSTC programme, to ensure that our portfolio of streams remains appropriate for fulfilling our key aim of providing excellent broadening training. We shall initiate such a review if we are awarded follow-on funding, and have made provision for part-funding of some more course development, if necessary. We note that DTZ carried out a full review of our management and administration, and found this to be sound.

The **SMSTC academic year** begins with a 2-day residential induction symposium in early October (held in Perth, since no universities are based there). A brief introduction or "taster" to each stream is given, and this allows students to meet SMSTC lecturers and ask questions about the contents and prerequisites. The aim is to help them to decide – in conjunction with their supervisors – which streams to register for. The symposium also incorporates the first tranche of the mathematical sciences generic skills programme, with talks on using bibliographic databases, giving tutorials, marking and the (essential!) "How to manage your supervisor" and there is also a session on internship possibilities. A team-building exercise (usually based around the Scottish national sport of curling) is also part of the activities.

There is another symposium midway through semester 2 at which students have an opportunity to discuss the

course material with their lecturers, to participate in a feedback session, and also attend an “inspirational” lecture: speakers so far have been Simon Singh (on making the documentary on Fermat’s last theorem), Professor Christl Donnelly (Imperial), Dr David Acheson (Oxford) and Professor Roger Heath-Brown (Oxford). The second tranche of the generic skills programme also takes place during this symposium. (The costs of the generic skills component of the events have hitherto been met from RCUK “Roberts” funds but this funding source is no longer available.)

Crucially, the initial and mid-session symposia enable students to mix and help them to become (and feel) part of the Scottish and UK mathematical sciences community. This is important both for their development, and for the future of UK mathematics. Indeed, we quote from the DTZ report: *Symposia – bringing the students together at the outset of the academic year in October and towards the end of the six month period in February is highly valuable in:*

- *briefing students and securing their buy-in to the SMSTC offer*
- *enabling students to establish relationships within their own university department and with students from other universities*
- *allowing some of the lecturers/supervisors from the member universities to come together and network in the context of postgraduate education.*

The **SMSTC lecture programme** runs from the week immediately following the Perth opening symposium, and each stream is taught in two-hour lectures over two 10-week semesters. The lectures are given to a local audience and delivered “live” by video conference equipment to the other sites during the afternoons of Monday–Thursday. (Staff typically have more teaching commitments in the mornings than afternoons, and if students are involved in teaching at tutorials, then these also generally take place in the mornings; on Fridays there are meetings of the Edinburgh Mathematical Society at venues around Scotland which students are encouraged to attend.) Material is designed to be suitable for a “standard” beginning EPSRC student, and is accessible to students from a range of specialisms. Such students normally take three streams, and so they spend about 75% of their time studying the course material during the first six months of their PhD programme. There is also **local support** for each stream (typically in the form of tutorials) provided by the home or a neighbouring university. Appropriate **assessment** is a cornerstone of the learning experience in each stream; the aim continues to be to ensure that the students actually learn something. The teaching team for each stream uses an assessment procedure (which may be by written or oral examination, project, or other means as appropriate), the results of which are submitted to the ASMG for approval. Individual departments are then informed of the results of their students on each stream and they take this into consideration at the end of year progress reviews.

The **SMSTC wiki**, www.smstc.ac.uk plays a central role in underpinning all the resources and communication of the centre. Lecture notes and lecture presentations are available there to registered participants and it acts as a central repository for all essential items of information that people involved with the SMSTC – as students, members of stream delivery teams, members of ASMG or members of consortium departments – may need.

We continue to believe the delivery model outlined above to be the best given the various constraints.

- Teaching the material over six months rather than in an intensive short burst gives students time to develop a deep understanding of the key concepts.
- Assessment provides a strong incentive to continue to keep up with and learn the material.
- Attending lectures by leading experts who are also good teachers is a very efficient and effective way to learn mathematics. Regular tutorials help to promote understanding and reinforce material.
- VC delivery of lectures is essential, since it would not be feasible for students to travel (possibly large distances) to attend three lectures a week. Also, individual departments would not be able to teach such a broad range of topics as can be offered collectively. Having dedicated VC equipment adds significant value to departments’ teaching by enabling collective expertise to be shared.

The SMSTC has deliberately decided to offer a **fixed suite of courses** rather than a collection of courses changing rapidly from year to year because our experience has shown us that even well-qualified undergraduates are often lacking in knowledge of fundamental mathematical material. The aim is to ensure that students taking a particular stream will be well-versed in the core material of the stream area upon completion of the

stream. This structure is in common with what is offered to beginning PhD students in North American and European universities. The courses naturally evolve from year to year as the lecturers place different emphases on the material and as the lecturers and indeed the stream leaders themselves rotate. (For example the Algebra stream has had three stream leaders to date.) Illustrative examples will also vary from year to year in the light of new developments at the cutting edge of research. There is therefore no question of the material ossifying and is indeed in a perpetual state of natural refreshment. The eight streams and development and delivery teams for the 2010/11 academic year are as follows (the stream leader is listed first):

Algebra: *Group Theory:* Basic concepts; constructions; generators and relations; simple groups; the Jordan-Hölder theorem; soluble groups; group actions; conjugation; Sylow theorems and applications. *Rings and Modules:* Definitions and basic properties; chain conditions; Hilbert Basis theorem; PIDs, Euclidean domains and UFDs; some elementary background on algebraic numbers and algebraic integers; finitely generated modules over a PID; Jordan canonical form of a matrix; the Artin-Wedderburn theorem; modules over semisimple Artinian rings. *Representation theory of finite groups:* Maschke's theorem; characters and character tables; tensor products; applications to groups such as Burnside's $p^a q^b$ -theorem. **Team:** Meinolf Geck (Aberdeen), Radha Kessar (Aberdeen), Uli Kraehmer (Glasgow), Tom Lenagan (Edinburgh), Max Neunhöffer (St Andrews), Colva Roney-Dougal (St Andrews), William Turner (Aberdeen).

Geometry and Topology: *Algebraic Topology:* Elements of general topology; the fundamental group and covering spaces and homotopy; fundamental group of S^1 and applications; deformation retractions and homotopy equivalence; free products of groups, group presentations, Seifert-Van Kampen theorem; compact orientable surfaces, CW complexes; the Galois correspondence for covering spaces; simplicial and singular homology. *Differential Geometry:* Euclidean space, local manifolds in \mathbb{R}^n , implicit function theorem, Sard's theorem; smooth manifolds, maps between smooth manifolds, tangent vectors; vector bundles on smooth manifolds, esp. the tangent bundle; curvature of smooth curves and surfaces in \mathbb{R}^3 ; linear connections, Christoffel symbols, geodesics; Theorema Egregium and Riemannian curvature. *Differential topology:* Manifolds with boundary; Brouwer fixed-point theorem; the mod-2 degree and applications; orientations, Brouwer degree and applications; Jordan-Brouwer separation theorem; transversality and intersections of maps and submanifolds; Vector fields and Euler number; Hopf index; differential forms on manifolds, integration on manifolds, exterior derivative, cohomology with forms, Stokes' theorem, integral definition of degree, Gauss-Bonnet Theorem. **Team:** Alastair Craw (Glasgow), Andrew Baker (Glasgow), Brendan Owens (Glasgow), Andrew Ranicki (Edinburgh), Michael Singer (Edinburgh), Richard Szabo (Heriot-Watt).

Pure Analysis: *Measure and Integration:* Concrete examples: Riemann and Lebesgue; abstract integration theory – convergence theorems; signed, product and Radon measures; fractal sets and Hausdorff dimension; L^p spaces; differentiation; Fourier series. *Functional analysis:* Banach and Hilbert spaces and operators between them; Baire's theorem, Open Mapping and Uniform Boundedness theorems; Hahn-Banach theorem; weak and weak* topologies; compact operators; spectral theory and C^* -algebras. **Team:** Jim Wright (Edinburgh), Rob Archbold (Aberdeen), Tony Carbery (Edinburgh), Kenneth Falconer (St Andrews), Alastair Gillespie (Edinburgh), Lars Olsen (St Andrews).

Applied Analysis and PDE: Dynamical systems and bifurcation. Systems of hyperbolic PDEs and shock waves. Analysis of parabolic and elliptic PDEs (including existence, uniqueness, maximum principles, energy estimates, monotone iteration, regularity, eigenfunctions). Sobolev imbeddings and trace theorems. Finite element approximations. **Team:** Jack Carr (Heriot-Watt), Mark Ainsworth (Strathclyde), Lyonell Boulton (Heriot-Watt), Michael Grinfeld (Strathclyde), Bryan Rynne (Heriot-Watt).

Applied Mathematics Methods: Asymptotic methods for differential equations (including multiple scales and boundary layers, singular perturbations, matched asymptotics). Contour integral methods for differential equations. Numerical methods (including IVPs, BVPs, numerical linear algebra, practical optimization). **Team:** Alan Hood (St Andrews), Magda Carr (St Andrews), Coralie Cartis (Edinburgh), Dugald Duncan (Heriot-Watt), Roger Fletcher (Dundee), David Griffiths (Dundee), Des Higham (Strathclyde), Ping Lin (Dundee), David Pritchard (Strathclyde).

Mathematical Models: *Introduction and Traffic-Flow Modelling.* *Continuum Mechanics and Elasticity:* Kinematics; balance laws and governing equations; observer transformations; constitutive laws; inviscid and viscous fluids; solid mechanics (elasticity). *Fluid Mechanics:* Newtonian fluid dynamics; non-Newtonian fluids; introduction to magnetohydrodynamics (MHD); applications of MHD - waves in the Sun's atmosphere; geophysical fluid dynamics. *Mathematical biology:* Population ecology; evolution of disease; biological waves; electro-cardiophysiology; modelling of cancer. **Team:** Rachel Norman (Stirling), Mark Chaplain (Dundee), Penny Davies (Strathclyde), Ineke De Moortel (St Andrews), Nick Hill (Glasgow), Andrew Lacey (Heriot-Watt), Kevin Painter (Heriot-Watt), David Pritchard (Strathclyde), Jonathan Sherratt (Heriot-Watt), Iain Stewart (Strathclyde), Jacques Vanneste (Edinburgh), Steven Webb (Strathclyde).

Probability: Foundations; conditioning & independence, random variables & their laws, important special distributions; convergence & related concepts; sequences of independent random variables; conditional expectation and martingales; martingale limit theorems and applications, Poisson processes, Markov chains in discrete and continuous time; ergodicity; elements of renewal theory and applications; simulation, MCMC and applications; Brownian motion; simple stochastic DEs. **Team:** Stan Zachary (Heriot-Watt), Terence Chan (Heriot-Watt), Sandy Davie (Edinburgh), Serguei Foss (Heriot-Watt), Istvan Gyöngy (Edinburgh), Takis Konstantopoulos (Heriot-Watt), Andrew Wade (Strathclyde).

Statistics: Introduction to R, review of linear models, likelihood methods (and optimisation), review of generalised linear models, simulation and bootstrapping, random effects models, modern regression (generalised additive models, etc), introduction to MCMC methods, case studies. **Team:** Adrian Bowman (Glasgow), Steve Buckland (St Andrews), Ruth King (St Andrews), Agostino Nobile (Glasgow).

Management and quality control

At the **strategic level** the Academic Steering and Management Group (ASMG), convened by the Director, and with representation from each contributing university and broad subject area, monitors quality and coordinates the development, delivery and assessment of the taught material. There are external advisors on the ASMG, which as well as being important for quality assurance, aids in the dissemination of good practice throughout the UK. In particular the ASMG, which meets at least twice yearly, is mandated to: oversee and review academic activities of streams; organise consultations with students and other interested parties; respond to comments by external members; oversee operation of SMSTC website and decide on necessary changes; plan symposia; consider proposals for new streams; appoint stream leaders as required (in practice the relevant subject community decides on who should be the next stream leader and the ASMG's role is to formally ratify this); advise stream leaders as necessary; ensure timeous communication of assessment results to students and participating institutions; consult with stream leaders prior to May meeting of ASMG; conduct annual Academic Review in May; decide upon and oversee any changes deemed necessary.

At the **operational level**, day-to-day administration is undertaken by the **International Centre for Mathematical Sciences (ICMS)**, overseen by the SMSTC director and deputy director. Its staff undertake all non-scientific organisation and administration for the SMSTC. This includes: creating and maintaining the SMSTC wiki; student registrations; booking lecture rooms and student and staff accommodation for the two symposia; timetabling of VC lectures and booking VC links through the central switch; publicity and marketing; dealing with all financial aspects; collating and recording data relating to assessment, and distribution of such data to client departments; organising the on-line feedback exercise for students and other interested parties; collating and recording information on the post-PhD destinations of students.

Overall **quality control** is ensured by the ASMG which continually monitors all aspects of the SMSTC's operation and in particular considers the performance of each stream annually in the light of an annual report submitted by the stream leader, feedback from the students and results of the assessment procedure. External representation on the ASMG ensures that objective standards are met. Suggestions for modification to the streams are offered by the ASMG yearly as part of the annual academic review. Stream Leaders are asked to comment on how they incorporated such suggestions from the previous session. The Stream Leaders and their delivery teams are responsible for ongoing development of excellent material and lecturing to a high standard. A continually updated series of communications on the wiki www.smstc.ac.uk provides information on best practice both for Stream Leaders and their teams.

New academic staff receive induction **training** on teaching from their universities as a matter of course. Each SMSTC consortium department provides training in how to operate the equipment to both lecturers and to the PhD students. Informal training for new SMSTC lecturers in the effective use of videotechnology for distance teaching is provided by more experienced users of the medium. Since each stream involves experts from a range of institutions, this means that good practice is shared between different departments and streams during the session. We are very pleased that a recent grant from EPSRC has allowed us to purchase new HD (High Definition) VC equipment at all seven sites, and this should provide a substantially enhanced teaching experience for staff and students. The new VC codec is a different make from the previous one, and we shall provide central and local training in its use this summer in good time for the next SMSTC academic year.

Financial strategy and charging regime

SMSTC's five-year financial model assumes that EPSRC will fund the current proposal at the total requested (£30k per year for five years) and that the consortium universities will continue to support the SMSTC's activities by incorporating SMSTC-related work into departmental workload models and permitting and encouraging staff to contribute freely to the SMSTC, as outlined in their support letters. The DTZ review of the SMSTC estimated that this university support is valued at £150k per year for the later years of centre's operation and is likely to be of the same order of magnitude over the next five years.

The fixed costs in setting up the Centre have been largely for VC equipment (which was recently refreshed as a result of an EPSRC grant) and initial course development. Annual costs charged to the grant will mainly be for the residential symposia (a lecture room and travel/subsistence for lecturers and subsistence for EPSRC students); administration (ICMS); website support and server space and ongoing course development costs.

The SMSTC's **charging regime** for the next five years will be as follows.

- All PhD students at consortium departments (and Stirling) can register for any SMSTC streams at no charge.
- All first year PhD students from these departments are invited to attend the two symposia. Students funded by EPSRC will have their accommodation and subsistence paid for from the grant, and departments will be charged for the accommodation and subsistence for their non-EPSRC students.
- PhD students from other departments at consortium universities can register for SMSTC streams at a cost of £100 per student per stream (they attend the lectures at their university's SMSTC VC room).
- PhD students from any other university can also register for SMSTC streams at a cost of £100 per student per stream, and there is an additional cost of £250 payable by the university (to cover the overhead of having to deal with an extra site on the VC bookings).
- The consortium departments also have an agreement that SMSTC streams can be used as a credit-bearing part of their Masters degrees (MSc and MMath), and there is an FTE-based charging formula for this.

The only change in this from what we do now is that the current EPSRC grant for SMSTC also pays the travel costs of EPSRC-funded students to attend the symposia. But the small amounts of money involved do not justify the high workload required to process these expenses centrally (the processing is further complicated by wrong claims by students who do not know who their funder is, which have to be sorted out later).

We have had some success in attracting interest in courses and materials from individuals and organisations outside the SMSTC consortium (from NUI Galway as well as students in science and engineering departments in consortium universities). Up until now we have mainly publicised SMSTC to mathematical scientists, but we plan to actively advertise our portfolio to departments within our universities. It is hoped that in the future, increases in this income stream will help ease the SMSTC into self-sustainability.

Sustainability strategy

Departments in the SMSTC have already made a **significant contribution** (of academic staff time for lecturing, course development, giving tutorials and SMSTC management; and provision of rooms and technical support for the VC lectures) during the set-up and four operational years to date, and have committed to continuing with this. The main external costs are for administrative support and the two annual symposia, and transitional funding from EPSRC of £150k will pay for these, and for additional course development. **This will enable SMSTC to continue operations at the current standard and range of service provision for another five years.**

After the end of the current proposal's activities, the annual symposia and administration costs will be need to be covered by departments, although we anticipate that increased income from students external to the SMSTC will help ease this financial burden. Departments will pay registration fees for their students on a subscription model similar to that described above for participation by students from departments outwith the consortium. The registration fees for EPSRC students will be paid from their DTA. The DTZ report notes that: "There is a genuine commitment to the continuation of the SMSTC Network going forward ... There has been too much time and effort invested in the initiative and the benefits are so substantial that the Scottish universities would not be prepared to let the SMSTC fold." Letters of support from SMSTC consortium departments are enclosed.

The recent grant from EPSRC has allowed us to completely refresh our VC equipment and upgrade to the new HD (High Definition) standard. This **new equipment** will be used from the 2011/12 SMSTC academic year and the codec is fully warrantied. A small proportion of funding will be allocated for minor repair and replacement of equipment (e.g. of data projector bulbs) over the next five years, with departments expected to take full responsibility for provision of suitable VC facilities after this. (The ongoing fall in costs of like-for-like computer and broadcast equipment means that this should not involve a substantial financial commitment.)

We shall continue to make SMSTC available to a wide range of potential customers outside the consortium and to expand this base as an aid to future sustainability. SMSTC was advertised extensively within the mathematical science community during its first funded period (with articles in the newsletters of the European and London Mathematical Societies, the Institute of Mathematics and its Applications and MSOR), and now that it is well-established it would be timely to advertise more heavily to science and engineering departments within our universities, especially those whose research involves high-level mathematics or statistics. The numbers of such “external” students is growing, with registrations in (especially) the statistics stream by students from bioscience and management science, and the applied mathematics streams by students from petroleum engineering. An enhanced external profile should allow us to increase registrations further.

Evaluation of impact of the courses

There is a good deal of evidence gathered in our own on-line feedback exercises and by DTZ that students participating in the SMSTC have a good measure of satisfaction in the courses they have attended. According to the DTZ report, about 60% of SMSTC students and supervisors regarded the breadth and range of training available as excellent or good; nearly 90% of students felt that the courses they had attended had been about broadening their knowledge outside the area of their PhD research. Over 80% felt that they expected to have a broader mathematical knowledge base outside their PhD research area through attending SMSTC courses. Overall over 50% felt that attending the SMSTC courses was of high or very high value, with less than 10% feeling that the value was limited or non-existent.

We quote from the DTZ report: ***Direct Student Impact** – the courses have been well received and the evidence from the assessment is that students are applying themselves, with the majority getting A and B grades. De facto one can deduce that they are broadening their mathematical education and the goal of the TCC initiative is being met.*

***Indirect Student Impact** – it is too early to say how this ‘broadening’ in their education will assist them in terms of:*

- *enhancing their doctoral education and their performance*
- *improving their future career performance, either staying in academia or securing alternative employment in the public or private sectors.*

However, there is anecdotal evidence that students are now talking amongst themselves much more, sharing academic problems and working in a more team focused way. This is considered to be an important added value contribution from SMSTC in that it is getting students out of their narrow PhD subject area and mixing with a wider cohort of fellow students and academics than would otherwise be the case.

***Wider Impacts** – an important indirect impact generated by the formation of the SMSTC has been the improved networking and communication across the Scottish Universities at departmental level. It has helped to ‘break down silos’ and develop a more collaborative approach towards the furthering of mathematical sciences in Scotland. It has also enhanced university perceptions of ICMS and its contribution to mathematical sciences.*

We are collecting data on the employment of recently graduated PhD students, and will continue to survey all graduating students. The metrics by which the outcomes and impact of the SMSTC’s taught course programme will be evaluated include the following.

- The number of students who obtain postdoctoral positions upon graduation.
- The numbers of students who obtain permanent academic jobs in the UK and elsewhere.
- The percentage of SMSTC mathematical sciences PhD students who obtain non-academic research jobs, compared to available HESA data.

In our original proposal five years ago we stated that “the potential impact of the taught course programme will be recognised in the 2009 IRM, and subsequent IRMs will contain favourable comments about the increased competitiveness and excellence of UK PhDs in Mathematics.” We feel the comments on the TCCs expressed in the 2010 IRM – and feedback in the 2008 RAE exercise – do indeed bear out the optimism we expressed.

C Pathways to impact

Since the aim of the TCC initiative is to provide core student training, it is clear that the main impact of this proposal will be in the **people** and **knowledge** categories. But because a large proportion of PhD graduates are employed outwith academia, there will also be significant impact on **society** and the **economy**.

People

SMSTC's core aim is to provide high quality broadening training in the mathematical sciences to first year PhD students, equipping them with **skills** in a range of mathematical and statistical techniques. This should enable students to recognise and exploit connections between different branches of mathematical sciences and thus enhance their ability to do research at a high level. SMSTC also provides generic skills training in key areas which support research, such as using bibliographic databases, report writing and giving talks.

There is an acknowledged problem in the **people pipeline** within UK mathematical sciences, with UK PhD students finding it hard to compete with those whose PhD programmes involve a substantial taught component. This is compounded by the low numbers of postdoctoral positions available for mathematical scientists in the UK. The recent International Review report¹ notes the low proportion of UK-trained mathematical scientists amongst new academic appointments and says: *the panel regards this fragility as a serious potential risk to the UK's future international standing*. The goal of SMSTC is to broaden our students' mathematical perspective to bring their experience more into line with international norms, so they are more competitive in the academic employment market.

Knowledge

The fundamental aim of SMSTC is to enhance the PhD programme by teaching our students a broad range of mathematical and statistical ideas and **techniques**. This will equip them with the necessary background knowledge to make **scientific advances** in their research during (and after) the PhD.

Economy and society

A large proportion of mathematical sciences PhD students enter employment outwith academia². They are highly prized by employers, as shown for example by starting salaries. For example, the table below gives the average salary of undergraduates and postgraduates six months after graduation in 2007/08³.

Subject	First degree	Postgraduate
Biological sciences	£16,500	£22,500
Physical sciences	£19,000	£24,000
Computer science	£21,000	£24,000
Engineering & technology	£23,000	£25,500
Mathematical sciences	£22,500	£27,000

A broader mathematical knowledge as provided by SMSTC will undoubtedly increase the value of mathematical sciences postgraduates to the economy and society.

¹International Review of Mathematical Sciences, Draft report presented on 28 January 2011

²See p 37 of the Vitae report *What do researchers do?* available from www.vitae.ac.uk

³Taken from the table on p 94 of Adrian Smith's report *One Step Beyond: Making the most of postgraduate education* (March 2010)

D Justification of resources

1. Management and coordination

- The largest single cost for which we request funding is **day-to-day administrative support**. This is essential for SMSTC to continue to operate effectively, and includes: creating and maintaining the SMSTC wiki; student registrations; booking lecture rooms and accommodation for the two symposia; timetabling of VC lectures and booking VC links through the central switch; publicity and marketing; dealing with all financial aspects; collating and recording data relating to assessment, and distribution of such data to client departments; organising the on-line feedback exercise for students and other interested parties; collating and recording information on the post-PhD destinations of students. All non-scientific organisation and administration will be undertaken by ICMS, and the cost will be **0.45 FTE of a grade 5 administrator at point 21**. The total current employment cost of this (i.e. salary + NI + superannuation) is £13,710 per year. This is higher than charged to the current grant (0.35 FTE) because experience in managing SMSTC has shown that this is a more realistic percentage of staff time required. A lot of the initial organisation and set-up was carried out by academic staff while SMSTC was being established (and not charged to the current grant), and the administrator has gradually taken over most of these roles while SMSTC has been in operation.
- The **SMSTC wiki website** www.smstc.ac.uk underpins all the resources and communication of the centre: it acts as a central repository for all essential items of information, including lecture notes and slides. We request resources to provide central IT support for the wiki (to help the administrator with any problems, provide regular upgrades and patches to the software and ensure that it remains secure), and estimate this as about £1500 per year. We also request the cost of hosting it on a commercial server (JANet now provides a commercial web hosting service at a cost of £288 (inc VAT) this year, and we estimate £300 as the average over the next 5 years).
- We will be using the new HD (High Definition) VC equipment at the seven consortium sites from the 2011/12 SMSTC academic year and each codec is fully warranted. We request a funding for **minor repair and replacement of equipment** (e.g. data projector bulbs), and for **local AV support** at the seven sites. Our estimate of this is £8125 chargeable to the grant over the next five years (or £1625 per year), with anything over this paid by the departments.
- Another substantial external cost for SMSTC is that of the **two annual symposia**, which (as noted by DTZ) form a very valuable part of the SMSTC year. The costs are for room hire for the two symposia (this includes refreshments and hire of ice time and instruction for the curling "team building" event); an inspirational external speaker for symposium 2; staff accommodation and subsistence to attend the symposia (based on 10 staff at a cost of £145 each), and staff travel. (Student costs are listed in the next section.)
- The final item in this section is the costs of (local and external) staff to attend the **ASMG meetings** (two meetings per year for locals, one per year for externals).

Summary of coordination costs

Description	per year (£)	5 years (£)
Administration (employment cost of 0.45 FTE at point 21)	13,710	68,550
Web site (server space)	300	1,500
Central IT support	1,500	7,500
AV equipment & local support	1,625	8,125
Symposia: room hire	2,500	12,500
Symposia: external speaker costs and honorarium	500	2,500
Symposia: staff accommodation & subsistence	1,450	7,250
Staff travel to symposia & ASMG	1,100	5,500
ASMG: externals' travel & accommodation	600	3,000
Coordination: total	23,285	116,425

2. Students' costs

We shall hold two symposia each year. The first one (in Perth) will contain a brief introduction to each stream, some generic skills sessions, and a team building exercise. The second will include a problem-solving and feedback session for each stream, skills training and an inspirational lecture. Annual costs are estimated on the basis of 27 EPSRC students @ £145 subsistence and accommodation per person. Departments will pay the costs of their non-EPSRC students.

Students' costs		
Description	per year (£)	5 years (£)
Accommodation & subsistence of 27 students at symposia (£145 each)	3,915	19,575
Students': total	3,915	19,575

3. Course development

We shall hold an academic review of the whole SMSTC programme to ensure that the portfolio of streams remains appropriate for the key aim of providing excellent broadening training in the mathematical sciences. Based on an estimate of 20 hours of new lecture material at a preparation time of 5 days each (to allow for the introduction of a new stream, or modification of the existing streams), this gives 100 days of work for course development. Assuming this is carried out by people at an average cost of the top of the senior lecturer scale (grade 9, point 44, total employment cost of £65,666), this gives a total **course development cost estimate of £29,848**. We request funding to cover £14,000 of this, with the rest of the cost borne by the contributing departments.

Course development		
Description	per year (£)	5 years (£)
Contribution to course development	2,800	14,000
Course development: total	2,800	14,000

4. Total resources requested

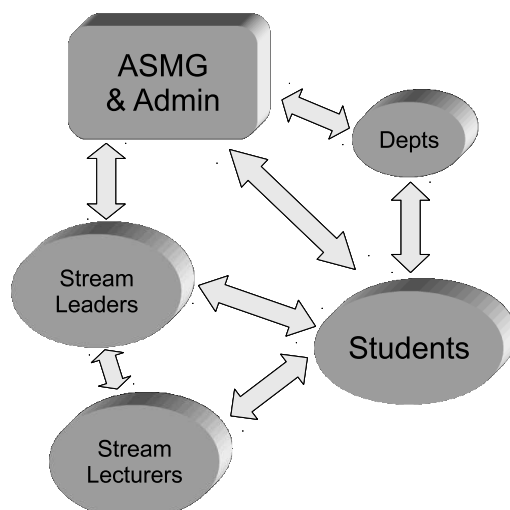
The sum of resources requested for **management and coordination, students' costs** and **course development** is tabulated below.

Category	per year (£)	5 years (£)
Management and coordination	23,285	116,425
Students' costs	3,915	19,575
Course development	2,800	14,000
Total requested	30,000	150,000

5. Resources available elsewhere

The entire SMSTC operation will continue to depend crucially on the contributions of the contributing departments in terms of academic staff time for course delivery and management, technical expertise and provision of accommodation for the VC lectures. The value of this contribution (i.e. the cost borne by contributing departments) is calculated to be at least £150,000 per year, or **£750,000 over the next five years**.

E Diagrammatic Workplan: SMSTC management structure



The SMSTC year

- **June:** Preliminary bookings for symposium (venue, catering, accommodation and restaurant) and cost estimate for non-EPSRC students. Publicise key dates to departments and stream leaders and update wiki.
- **August:** Archive wiki material and create new stream pages, programme and registration form for the coming academic year.
- **September:** SMSTC registration opens — ensure that departments tell all their new students. Check VC equipment and provide training for any new lecturers. Update the list of departmental postgraduate coordinators and VC room details. Finalise symposium details.
- **October:** Symposium 1. SMSTC lectures begin. Students confirm stream registrations, and information is sent to stream leaders. Arrangements for November ASMG meeting confirmed. Departments invoiced for non-EPSRC students at symposium 1.
- **November:** ASMG meeting and confirm date for May/June meeting.
- **December:** Make bookings for symposium 2 and confirm arrangements with external speaker. End of semester 1 teaching. Confirm broadcast schedule for semester 2 and make JANet bookings.
- **January:** Registration opens for symposium 2. Start of semester 2 teaching. Finalise programme for symposium 2 and confirm staff attendances.
- **February:** Symposium 2. Departments invoiced for non-EPSRC students.
- **March:** Prepare evaluation questionnaires (for students and for staff), upload them to the wiki and publicise them. End of semester 2 teaching.
- **April–May:** Obtain student assessment grades from stream leaders and collate. Stream leaders prepare academic reports Questionnaire responses formatted and summarised. ASMG meeting. Student grades sent to students and Heads of Departments. Management section information updated and minutes uploaded. Response to student questionnaire comments uploaded to wiki.



Division of Mathematics
University of Dundee
Dundee DD1 4HN
Scotland
06 May 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The Division of Mathematics at the University of Dundee is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The Division agrees to make the following **educational** commitments to SMSTC.

- First year students funded by EPSRC shall normally take three SMSTC streams (or equivalent broadening training in mathematical sciences).
- The SMSTC video lectures will be underpinned by locally provided tutorials or other support as required.
- A student's performance on SMSTC (or equivalent) assessment will be considered during his/her end of year progress review.

We also agree to make the following **financial** commitments.

1. To pay the travel costs for our EPSRC-funded first year students to attend the two annual symposia (acknowledging that accommodation and subsistence for such students would be paid from the grant). In addition we hope to be able to pay the costs for any other first year students to attend these events (we have done this during each year of SMSTC's operations so far).
2. To provide a room that can be used to broadcast and receive SMSTC video lectures, and local support for the new video-conference equipment (so that academic staff and students are supported in using it).
3. To provide staff to teach on SMSTC streams (with the workload commensurate with the size of the PhD student population).
4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.

Professor Mark A.J. Chaplain

Role: Head of Division





2nd May 2011

SCHOOL of MATHEMATICS

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Telephone 0131 650 1000
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Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The School of Mathematics at the University of Edinburgh is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The School agrees to make the following **educational** commitments to SMSTC.

- First year students funded by EPSRC shall normally take three SMSTC streams (or equivalent broadening training in mathematical sciences).
- The SMSTC video lectures will be underpinned by locally provided tutorials or other support as required.
A student's performance on SMSTC (or equivalent) assessment will be considered during his/her end of year progress review.

We also agree to make the following **financial** commitments.

1. To pay the travel costs for our EPSRC-funded first year students to attend the two annual symposia (acknowledging that accommodation and subsistence for such students would be paid from the grant). In addition we hope to be able to pay the costs for any other first year students to attend these events (we have done this during each year of SMSTC's operations so far).
2. To provide a room that can be used to broadcast and receive SMSTC video lectures, and local support for the new video-conference equipment (so that academic staff and students are supported in using it).
3. To provide staff to teach on SMSTC streams (with the workload commensurate with the size of the PhD student population).
4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.

Yours sincerely

Prof Michael Singer
Head of School



5th May 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The School of Mathematics and Statistics at the University of Glasgow is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The School agrees to make the following **educational** commitments to SMSTC.

- First year students funded by EPSRC shall normally take three SMSTC streams (or equivalent broadening training in mathematical sciences).
- The SMSTC video lectures will be underpinned by locally provided tutorials or other support as required.
- A student's performance on SMSTC (or equivalent) assessment will be considered during his/her end of year progress review.

We also agree to make the following **financial** commitments.

1. To pay the travel costs for our EPSRC-funded first year students to attend the two annual symposia (acknowledging that accommodation and subsistence for such students would be paid from the grant). In addition we hope to be able to pay the costs for any other first year students to attend these events (we have done this during each year of SMSTC's operations so far).
2. To provide a room that can be used to broadcast and receive SMSTC video lectures, and local support for the new video-conference equipment (so that academic staff and students are supported in using it).
3. To provide staff to teach on SMSTC streams (with the workload commensurate with the size of the PhD student population).
4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.

Professor N Hill
Head of School

School of Mathematics & Statistics

Mathematics Building, 15 University Gardens, University of Glasgow, Glasgow, G12 8QW
Tel: +44 (0)141 330 5024/5176 Fax: +44 (0)141 330 4814

The University of Glasgow, charity number SC004401

3 April 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The School of Mathematical and Computer Sciences at Heriot-Watt University is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The School agrees to make the following **educational** commitments to SMSTC.

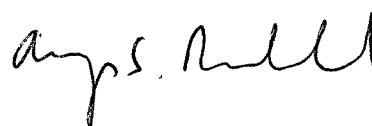
- First year students funded by EPSRC shall normally take three SMSTC streams (or equivalent broadening training in mathematical sciences).
- The SMSTC video lectures will be underpinned by locally provided tutorials or other support as required.
- A student's performance on SMSTC (or equivalent) assessment will be considered during his/her end of year progress review.

We also agree to make the following **financial** commitments.

1. To pay the travel costs for our EPSRC-funded first year students to attend the two annual symposia (acknowledging that accommodation and subsistence for such students would be paid from the grant). In addition we hope to be able to pay the costs for any other first year students to attend these events (we have done this during each year of SMSTC's operations so far).
2. To provide a room that can be used to broadcast and receive SMSTC video lectures, and local support for the new video-conference equipment (so that academic staff and students are supported in using it).
3. To provide staff to teach on SMSTC streams (with the workload commensurate with the size of the PhD student population).
4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.



Professor Jim Howie,
Head of Mathematics

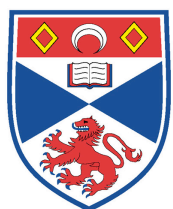


Professor Angus Macdonald,
Head of Actuarial Mathematics and Statistics

Mathematics

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University
of
St Andrews

University of St Andrews

Professor Nik Ruškuc
Head of School
School of Mathematics and Statistics

28 April 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The School of Mathematics and Statistics at [the University of St Andrews is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The School agrees to make the following **educational** commitments to SMSTC.

- First year students funded by EPSRC shall normally take three SMSTC streams (or equivalent broadening training in mathematical sciences).
- The SMSTC video lectures will be underpinned by locally provided tutorials or other support as required.
- A student's performance on SMSTC (or equivalent) assessment will be considered during his/her end of year progress review.

We also agree to make the following **financial** commitments.

1. To pay the travel costs for our EPSRC-funded first year students to attend the two annual symposia (acknowledging that accommodation and subsistence for such students would be paid from the grant). In addition we hope to be able to pay the costs for any other first year students to attend these events (we have done this during each year of SMSTC's operations so far).

Mathematical Institute, North Haugh, St Andrews, Fife KY16 9SS, Scotland, U.K.
Tel: 01334 463787 Fax: 01334 463748 email: mathshead@st-and.ac.uk

2. To provide a room that can be used to broadcast and receive SMSTC video lectures, and local support for the new video-conference equipment (so that academic staff and students are supported in using it).
3. To provide staff to teach on SMSTC streams (with the workload commensurate with the size of the PhD student population).
4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.



Nik Ruškuc
Head of School

Department of Mathematics and Statistics

27 Apr. 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

The Department of Mathematics and Statistics at the University of Strathclyde is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The Department of Mathematics and Statistics agrees to make the following **educational** commitments to SMSTC.

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Professor Xuerong Mao FRSE
Head of Department

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Institute of Mathematics
School of Natural and Computing Sciences
University of Aberdeen
4 May 2011

Dr Vivienne Blackstone
Mathematical Sciences Portfolio Manager
Mathematical Sciences Programme
EPSRC

Dear Dr Blackstone,

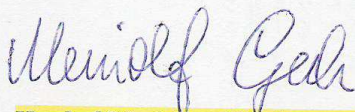
The Institute of Mathematics, within the School of Natural and Computing Sciences at the University of Aberdeen, is pleased to support the application for follow-on funding for the Scottish Mathematical Sciences Training Centre (SMSTC). Funding for a further period of five years should greatly ease the SMSTC's transition to full self-sustainability.

The Institute agrees to make the following **educational** commitments to SMSTC.

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4. We note that the **total financial commitment** of staff time and room costs from the Scottish institutions for SMSTC will be approximately £150,000 per year.



Role: **Head of Discipline (Mathematics)** in the School of Natural and Computing Sciences