PhD Opportunities in Mathematics

The Department of Mathematical Sciences is a large research active department with an established international reputation. It is also home to three University Research Centres. Results of the 2008 Research Assessment Exercise show that within the London area, in the field of Statistics and Operational Research, we were rated as the second best research department - equal to the London School of Economics, second to Imperial College. In Applied Mathematics we were rated as the third best research department, behind King's College and Imperial College.

Academic staff are internationally recognised for their high quality research output in a number of areas of modern mathematics. Within our active teaching and research environment there are many postgraduate research opportunities, and our research degrees are highly successful at providing state of the art preparation for future successful career opportunities.

PhD and MPhil Research Degrees

A PhD degree is a research degree that typically takes three years as a full-time student, or four years as a part-time student. For the award of PhD you must show a satisfactory record of research and a thorough knowledge of the field of scholarship. You're also required to demonstrate a broad knowledge and understanding of your discipline and of associated research techniques and to show that they have been successfully applied. Your PhD research is presented in the form of a thesis and a distinct and original contribution to knowledge in the discipline must be demonstrated

An MPhil degree is a research degree that typically takes one year as a full-time student to complete, or two year's as a part-time student. For the award of MPhil you're expected to demonstrate a satisfactory record of research, a broad knowledge and understanding of the field of study and of associated research techniques and to show that they have been successfully applied.

Research Groups

Applied Analysis Combinatorics Computational Mathematics Continuum Mechanics
Mathematical Physics Operational Research and Risk Modelling Statistics

Research Centres

BICOM Brunel Institute of Computational Mathematics
BURSt Brunel University Random Systems Research Centre
CARISMA Centre for the Analysis of Risk and Optimisation

Get in touch to discuss PhD / MPhil courses

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PhD Opportunities in Mathematics at Brunel

The **Applied Analysis Group** specialises in the rigorous analysis of mathematical models from Biology, Physics, Engineering and Finance, exploiting a wide range of advanced techniques, including

- Linear and nonlinear functional analysis,
- Asymptotic & perturbation methods,
- Boundary-domain integral and Integro-differential equations,
- System identification algorithms,
- Orthogonal polynomials

Dr Paresh Date Dr Jacques Furter Dr Ilia Krasikov Dr Igor Krasovsky

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Research in **Combinatorics** covers a wide range of topics in graph theory, matroid theory, orthogonal polynomials and random matrices. For detailed descriptions of our research as well as other relevant information (collaborations, lists of publications, projects) please follow the links to the web pages of individual group members. Recent research includes:

- Investigating graph polynomials such as the Tutte polynomial, in particular their complexity.
- Researching into polynomial inequalities and non-asymptotic bounds for orthogonal polynomials
- Establishing new strengthenings of 3-connectivity in matroids as a tool to prove chain-type or slitter-type theorems
- Calculating asymptotics of orthogonal polynomials and asymptotics of related Toeplitz, Hankeland Fredholm determinants.
- Investigating the frequency assignment & related graph colouring / labelling problems, for example, determining the complexity of the L(2,1) labelling problem for outerplanar and planar graphs.
- Establishing new bounds for the 3x+1 problem

Dr Rhiannon Hall Dr Ilia Krasikov Dr Igor Krasovsky Dr Nenad Mladenovic
Dr Steven Noble

Continuum Mechanics The department has an active and thriving group of applied mathematicians that considers various aspects of acoustic, elastic, electro-magnetic, and water wave propagation phenomena. Dynamic responses are analysed for both continua and solid structures, in particular for thin elastic shells characterised by the presence of natural small geometric parameter. Many of these investigations are motivated by important practical problems and require advanced mathematical techniques, such as, the Wiener-Hopf technique, transform methods, asymptotic methods, and perturbation techniques. This also involves numerical methods and symbolic computation.

Specific applications in acoustics and electromagnetism include noise-reduction by novel duct design and the use of absorbent linings, the optimum placing of mobile phone masts. In water waves we consider violent free-surface deformations due to water entry/exit and wave impact on marine structures. Thin shell theory, in addition to the applications in mechanical, aerospace, naval and civil engineering, has more recently been found to be useful for the design and non-destructive testing of nanostructures, thin coatings and interfaces, micromechanical electronic systems, and biomedicine.

Dr Martin Greenhow Professor Julius Kaplunov Dr Jane Lawrie
Professor Sergey Mikhailov Dr Evgeniya Nolde Professor Tony Rawlins

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Mathematical Physics The research activities of our group cover a variety of topics ranging from high energy physics to mesoscopic disordered systems and non-equilibrium statistical mechanics. A prominent place in our research is occupied by Random Matrix Theory both as a tool for the study of various physical phenomena and as an object of study in its own right. The following list contains our main research activities together with the names of group members who are active in these areas. For more detailed descriptions of our research as well as other relevant information (collaborations, lists of publications, projects, etc.) please follow the links to the web pages of individual group members.

- Random Matrix Theory (Akemann, Its, Krasovsky, Rodgers, Savin, Smolyarenko)
- Quantum chromodynamics and high energy physics (Akemann)
- Integrable models and asymptotic analysis (Its, Krasovsky)
- Non-equilibrium statistical mechanics applied to economics and social sciences (Rodgers)
- Waves in disordered / chaotic systems and quantum chaos (Savin, Smolyarenko)

Professor Gernot Akemann Professor Alexander Its Dr Igor Krasovsky
Professor Geoff J Rodgers Dr Dmitry Savin Dr Igor Smolyarenko Dr Ian Williams

PhD Opportunities in Mathematics at Brunel

BICOM The **Brunel Institute of Computational Mathematics** has the objective to stimulate and execute research work within the broad areas of computational mathematics, applied analysis, mechanics and computational mechanics, and thus to contribute to the mathematics research and teaching programme at Brunel University. Current research is centred on mathematical modelling, finite element, boundary element and boundary domain integral equation methods and applications.

More generally, within the institute, work is proceeding on the mathematical theory, application and computational implementation of finite element and boundary element methods, and is financed by research grants and industrial contracts. Recently, new results have been obtained for a posteriori error estimates for finite element approximations of problems in viscoelasticity, discretization techniques for problems of acoustics, pattern forming in mathematical biology, thin structures and structural dynamics, the mathematics of fracture and thermoconductivity.

A feature of the activity of the Institute is collaborative research with colleagues from many parts of the world. **BICOM** normally has, at any one time, a number of researchers of this type spending extensive periods at the University. Several general finite element packages are available within the Institute for computing numerical solutions to problems from continuum mechanics.

Professor John Whiteman DIRECTOR OF BICOM
Professor Julius Kaplunov Dr Matthias Maischak Professor Sergey Mikhailov
Dr Evgeniya Nolde Dr Simon Shaw Dr Mike K Warby Dr Matthias Winter

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BURSt Brunel University Random Systems Research Centre
Research Centre people work in the following three Research Groups:

Mathematical Physics Research Group research in the following areas: random matrix theory, non-equilibrium statistical mechanics applied to economics and social sciences, waves in disordered / chaotic systems and quantum chaos, quantum chromodynamics and high energy physics, integrable models and asymptotic analysis.

Combinatorics Research Group research in the following areas: graph polynomials, polynomial inequalities, matroids, asymptotics of orthogonal polynomials and related determinants, frequency assignment problem and graph colouring.

Operational Research and Risk Modelling Research Group research in the following areas: financial engineering: asset and liability management, enhanced indexation, index tracking, pricing; mathematical programming: linear, integer and stochastic programming; metaheuristics: population heuristics, tabu search, variable neighbourhood search; risk: especially within finance, value at risk.

The scientific objective of the centre is to investigate and develop the theory of random systems. By random systems we mean a broad variety of theoretical questions and applications. For example in Mathematical Physics random matrices describe the universal properties of many processes in nature, including quantum chromodynamics in high-energy physics, quantum chaos, the Riemann hypothesis in number theory and fluctuations in stock prizes in economics.

In Graph theory polynomials, such as the Tutte Polynomial, link diverse areas such as statistical physics, random networks and knot theory. Complex networks have seen the emergence of new scale-free and small-world graphs. Joint graph theory/theoretical physics approaches may be used to develop the theory of their geometry and topology and to describe basic processes on them, such as diffusion, percolation, breakdown, conduction and transport.

In Operational Research and Risk Modelling the emphasis is on finding such concepts in finance, in particular through the evaluation of risk.

The research methodologies employed within BURSt include non-equilibrium statistical mechanics, matrix integrals, saddle-point techniques and orthogonal polynomials from mathematical and theoretical physics, graph polynomials, computational complexity and matroids from discrete mathematics and optimization methods and Bayesian networks from operational research. Within BURSt, there is a strong emphasis on analytical solutions and on the rigorous treatment of simply posed problems.

Professor Geoff J Rodgers DIRECTOR OF BURST Professor Gernot Akemann
Dr Dmitry Savin Professor John E Beasley Professor Ken Darby-Dowman
Dr Paresh Date Dr Rhiannon Hall Dr Ilia Krasikov Dr Igor Krasovsky
Dr Steven Noble Dr Nenad Mladenovic Dr Igor Smolyarenko Dr Ian Williams

PhD Opportunities in Mathematics at Brunel

Statistics There is a particular interest in Bayesian Inference, Classification, Non-parametric and Semi-parametric Modelling, Quantile Regression and Stochastic processes especially Hidden Markov models. In addition to theoretical and computational research, the group is also active in the application of its work in areas such as finance, actuarial science, environment, economics and health, statistical bioinformatics, statistical design of microarray experiment

Mrs Susan Browne Dr David Cappitt Professor David Hand Dr Xiaochen Sun
Dr Allan Tucker Dr Veronica Vinciotti Dr Keming Yu

CARISMA The **Centre for the Analysis of Risk and Optimisation Modelling Applications** is an interdisciplinary research centre which is supported by the strategic research initiative of Brunel University.

The mission of **CARISMA** is to be a centre of excellence recognised for its research and scholarship in the following areas

- the analysis of risk
- optimisation modelling
- the combined paradigm of risk and return quantification

We research in the following areas

- financial engineering: asset and liability management, enhanced indexation, index tracking, pricing
- mathematical programming: linear, integer and stochastic programming
- metaheuristics: population heuristics, tabu search, variable neighbourhood search
- risk: especially within finance, value at risk

Within the London area, in the 2008 Research Assessment Exercise with respect to *Statistics and Operational Research* we were rated as the second best research department, equal to the London School of Economics, second to Imperial College.

If you are considering becoming a PhD student with us then we offer:

- academic staff who are internationally recognised as researcher leaders within their disciplines
- academic staff who are have extensive experience of supervising PhD students from inception to successful completion
- the opportunity to experience three years in a stimulating intellectual environment within a large body of students researching in similar areas

Professor Gautam Mitra DIRECTOR OF CARISMA
Professor John E Beasley Professor Ken Darby-Dowman Dr Paresh Date
Mr Dan Di Bartolomeo Dr Frank Ellison Professor David Hand Dr Cormac Lucas
Professor Dilip Madan Dr Leelavati Mitra Dr Diana Roman Dr Katharina Schwaiger
Dr Xiaochen Sun Dr Simon Taylor Dr Veronica Vinciotti Dr Keming Yu

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