

## Learning Without Borders



Dr. Adil Jhangeer PhD Class of 2011 Professor and Chair Department of Mathematics, Namal University



MS Class of 2019 Executive Sales Manager Strategic (ESMS), T-Mobile



#### **MAHNOOR KHAN**

MS Class of 2020 Software Engineer, 10Pearls



## MS & PhD MATHEMATICS

Syed Babar Ali School of Science and Engineering

## **CREATING IMPACT THROUGH RESEARCH**



The Syed Babar Ali School of Science and Engineering (SBASSE) at LUMS offers undergraduate, graduate, and doctoral degrees in a wide range of disciplines.

The MS programmes at SBASSE impart specialised professional and research-oriented training to students. To graduate, students must complete a total of 30 credit hours, namely, 24 from coursework and 6 from research work.

The SBASSE PhD programmes prepare students to think scientifically and conduct high-quality research independently. The requirements for PhD degree include coursework completion, passing the PhD qualifying examination, research proposal defense, at least one peer-reviewed journal article and final thesis defense.

MATHEMATICS

## WHY CHOOSE **SBASSE**

## **QS World University**

Rankings by Subject

#301-350 Computer Science and Information Systems
#351-400 Engineering – Electrical and Electronics
#401-450 Engineering and Technology
#501-550 Physics and Astronomy

### Key Initiatives at the Department of Mathematics

The mathematics department at SBASSE-LUMS has gained prominence for high-quality teaching, and activities related to mathematical research and outreach.

• John Conway Spirited Seminar Series

John Conway Spirited Seminar series started in 2021 by the Department of Mathematics at the Syed Babar Ali School of Science and Engineering, LUMS. These online seminars allow eminent mathematicians from all over the world to engage in productive discussions on emerging trends in mathematics, exposition, and research.

- Graduate Students' Seminar
   The Graduate Students' Seminar is a scholarly meeting point where faculty and students discuss aspects of their mathematical research. These seminars provide an opportunity for students at all levels to learn about ongoing research within the department and promote research collaboration.
- LUMS MATH CIRCLES
   LUMS math circles is an initiative by the
   Department of Mathematics that aims to
   provide a platform for school kids where
   they can experience the intricacies of
   mathematical thinking, and that propagates
   the culture of doing mathematics, and
   creating knowledge. Math Circles expand the
   scope of teaching to include school students
   and provide profound, rigorous, playful, and
   life-altering experiences.

EMERGING REGIONAL CENTRE OF EXCELLENCE In recognition of the department's ongoing endeavors, the European Mathematical Society (EMS) has awarded it the status of an Emerging Regional Centre of Excellence (ERCE). As an ERCE bearer, the department has been organising various activities to create opportunities for collaboration between students and researchers.

#### **ICTP AFFILIATED CENTRE**

Another honour received by the department is its selection as an **ICTP's Affili-ated Centre** by the Abdus Salam International Centre for Theoretical Physics (ICTP). As an ICTP's Affiliated Centre, the department hosts the prestigious International Mathematics Master programme.

#### HOST FOR CIMPA RESEARCH SCHOOL

The Centre International de Mathématiques Pures et Appliquées (CIMPA) France selected the Mathematics Department at SBASSE to host **CIMPA Research School** on Algebraic and Combinatorial Methods in Geometry in March 2022.

#### COMPUTATIONAL FACILITIES

A high-performance computing centre provides computing facilities to faculty and students with specialised computational needs, engenders and facilitates research efforts, and provides research and development exposure to students. It is equipped with latest certified version of computing software like MAGMA, MACAULAY2, MAPLE, MATLAB and PYTHON.

### LEARNING WITHOUT BORDERS

Research and teaching at LUMS truly offer its community 'Learning Without Borders' by breaking academic, geographic and socioeconomic barriers to make education accessible to all. The University continues to be an intellectual hub, rich with varying perspectives and transformative ideas. With an environment brimming with inclusion, unity, and boundless knowledge, learning continues in and beyond the campus walls with the aim to develop innovators, leaders and change-makers who can contribute to the community and build strong borderless networks.

### TOP QUALITY PUBLICATIONS

SBASSE faculty have produced around 300 articles, all published in international venues of prestigious ranking.

### **RECOGNITION OF TOP RESEARCH THROUGH** SYED BABAR ALI RESEARCH AWARDS (SBARA)

These Awards recognise PhD students. The winners, called the Syed Babar Ali Fellows, are selected for the novelty of their research work, and the potential for lasting impact to their disciplines and the society.



# MS | PhD MATHEMATICS

## How will you launch your new world?

The Department of Mathematics comprises faculty members, students and research fellows studying and working across all fields within mathematics; ranging from Algebraic Topology to the Mechanics of Environment Systems. The Department is dedicated to conducting research in Pure as well as Applied Mathematics. Students have the opportunity to choose from many options, tailoring the programme to individual interests and requirements.

## **Fields of Research in the Department of Mathematics**

The research interests of faculty include areas of pure, applied, and computational mathematics. As a department we welcome interdisciplinary and cross-disciplinary research. A PhD applicant is required to carefully select one of the available faculty advisors on their background and interest in their prospective advisor's research area:

### SYMMETRIES OF DIFFERENTIAL EQUATIONS

Dr. Imran Naeem

## COMPUTATIONAL AND MATHEMATICAL BIOLOGY

Dr. Adnan Khan Dr. Sultan Sial Dr. Ashher Zaidi

### **SPECTRAL THEORY**

Dr. Muhammad Usman

## NUMERICAL METHODS, SCIENTIFIC COMPUTATION

Dr. Amer Rasheed Dr. Sultan Sial Dr. Zahra Lakdawala

### COMPUTATIONAL FLUID DYNAMICS, FLUID-STRUCTURE INTERACTION

Dr. Amer Rasheed Dr. Zahra Lakdawala

## **OPERATOR THEORY**

Dr. Masood Hussain Shah

#### COMMUTATIVE ALGEBRA, ALGEBRAIC GEOMETRY Dr. Imran Anwar

Dr Haniya Azam Dr. Shaheen Nazir

## ENUMERATIVE COMBINATORIAL ALGEBRA

Dr. Shaheen Nazir

## ALGEBRAIC TOPOLOGY, APPLIED TOPOLOGY, HOMOLOGICAL MIRROR SYMMETRY

Dr. Haniya Azam

#### **FINANCIAL MATHEMATICS**

Dr. Adnan Khan Dr. Sultan Sial



#### **DR. IMRAN ANWAR**

#### Associate Professor and Chair, Department of Mathematics

"Our graduate programme is demanding and requires exclusive time commitment and dedication. We offer several scholarships, financial assistance, travel support, and funding opportunities for students based on teaching/research-oriented collaborative projects. We believe in providing world-class facilities, international exposure, and freedom to our graduate students so that they can hone their intellectual strength and become independent researchers."



## Salient features of the MS Mathematics Programme in Partnership with ICTP, Italy

The MS Math Programme at SBASSE is a prestigious, two-year programme based on pragmatics with the following standout features:

- · Recruitment of top local and international talented students
- Selected students will be eligible for:
  - 1. Full fee waiver
  - 2. Free hostels
  - 3. Monthly stipend for two years as per university policy
  - 4. Air travel for international students
- Rigorous coursework on modern mathematics combined with cutting-edge research
- High-caliber faculty and visiting professors from leading institutions engaged in team teaching and joint supervision
- Opportunities for short-term research visits for students in leading research institutes
- Upon completion, students will get the IMM certificate endorsed by the ICTP along with the Master's degree from LUMS

Note: All students are required to be a Teaching Assistant for at least two courses during their study

### Salient features of the PhD Mathematics programme

The PhD Mathematics Programme at SBASSE is a full-time four-year programme that:

- Recruits top local and international talented students
- Provides four years of fully funded education
- Pays students a monthly stipend as per university policy
- · Combines rigorous coursework on modern mathematics with cutting-edge research
- Gives opportunities for short-term research visits
- Opportunities of additional funding for collaborative research and teaching

Note: All students are required to be a Teaching Assistant for at least two courses during their study

**A** MATHEMATICS

## **Leading Research Publications**

Be a part of our esteemed research groups as a graduate student

The excellence of a graduate programme is heavily based on the research portfolio of a department. Therefore, our graduate programme requires solid foundational knowledge of core mathematics and competence to indulge in rigorous problem-solving.

Faculty at the Department of Mathematics are actively publishing in prestigious journals:

Asgher Ali, Mudassar Imran, Sultan Sial, Adnan Khan, *Effective antibiotic dosing in the presence of resistant strains*, **Plos one** Volume 17, Issue 10 (2022).

M Ali, STH Shah, M Imran, A Khan, *The role of asymptomatic class, quarantine and isola-tion in the transmission of COVID-19*, Journal of Biological Dynamics 14 (1), 389-408 (2020).

I. Anwar, S. Nazir, *The f– and h–vectors of Interval Subdivisions*, Journal of Combinatorial Theory, Series A, 169, 105–124 (2020).

I. Anwar, S. Nazir, *On f– and local h–Vectors of the Interval Subdivision*, Journal of Algebraic Combinatorics, 53, 677–699 (2021).

I. Anwar, S. Nazir, *Combinatorial g-conjecture for Interval Subdivisions*, **Communications in Algebra**, 50(5), 1889–1905 (2022).

H. Azam, C. Blanchet, *Fukaya categories of surfaces*. Journal of Pure and Applied Algebra, 226.6, 106941 (2022).

H Azam, S Nazir, MI Qureshi, *The equivariant cohomology of weighted flag orbifolds*, **Mathematische Zeitschrift** 294, pages 881–900 (2020).

Yeol Je Cho, M. H. Shah, and N. Hussain, *Coupled fixed points of weakly F-contractive mappings in topological spaces*, **Applied Mathematics Letters**, 24, 1185—1190, (2011).

P. Exner, A. Laptev, M.Usman, *On Some Sharp Spectral Inequalities forSchrödinger Operators on Semiaxis*, **Communications in Mathematical Physics**, 326, 531–541 (2014).

Messoud Efendiev, Bruce van Brunt, Graeme C Wake, Ali Ashher Zaidi, *A functional partial differential equation arising in a cell growth model with dispersion Proceedings of the Royal Society* **A: Mathematical, Physical, and Engineering Sciences**, Volume 471 Issue 2179 Pages 20140947 (2018).

N. Hussain, M. H. Shah, A. Amini-Harandi and Z. Akhtar, *Common fixed point theorems for generalized contractive mappings with applications*, **Fixed Point Theory and Applications**, 2013:169 (2013).

AH Kara, FM Mahomed, I Naeem, C Wafo Soh, *Partial Noether operators and first integrals via partial Lagrangians*, **Mathematical Methods in the Applied Sciences**, 30 (16), 2079-2089 (2017).

M Khan, A Rasheed, *Numerical study of diffusion-thermo phenomena in Darcy medium using fractional calculus*, **Waves in Random and Complex Media**, Pages1-18 (2022).

M Khan, A Rasheed, A fast quantum image encryption algorithm based on affine transform and fractional-order Lorenz-like chaotic dynamical system, **Quantum Information Processing** 21 (4), 1-34 (2022).

M Khan, SA Lone, A Rasheed, MN Alam, *Computational simulation of Scott-Blair model to fractional hybrid nanofluid with Darcy medium*, **International Communications in Heat and Mass Transfer** 130, 105784 (2022).



A Khan, M Naveed, M Dur-e-Ahmad, M Imran, *Estimating the basic reproductive ratio for the Ebola outbreak in Liberia and Sierra Leone*, **Infectious diseases of poverty** 4 (1), 1-8 (2015).

A Khan, M Imran, *Optimal dosing strategies against susceptible and resistant bacteria*. **Journal of Biological Systems**, 26 (01), 41-58 (2018).

FM Mahomed, I Naeem, A Qadir, *Conditional linearizability criteria for a system of third-order ordinary differential equations* **Nonlinear Analysis: Real World Applications** 10 (6), 3404-3412 (2009).

Abdul Majid, Sultan Sial, *Approximate solutions to Poisson–Boltzmann systems with Sobolev gradients* **Journal of Computational Physics**, Volume 230, Issue 14 (2011).

I Naeem, FM Mahomed, *Approximate partial Noether operators and first integrals for coupled nonlinear oscillators*, **Nonlinear Dynamics** 57 (1), 303-311 (2009).

S. Nazir, V. Welker, *On the Homeomorphism and Homotopy Type of Complexes of Multichains*, **Annals of Combinatorics**, DOI: 10.1007/s00026-022-00626-y (2022).

M. H. Shah, Suzana Simic, N. Hussain, A. Sretenovic, and S. Radenovic, *Common fixed points theorems for occasionally weakly Compatible pairs on cone metric type spaces*, **Journal of Computational Analysis and Applications**, Vol.14, No.2, 290-297 (2012).

S Sial, J Neuberger, T Lookman, A Saxena Energy minimization using Sobolev gradients: application to phase separation and ordering, Journal of Computational Physics, Volume 189, Issue 1 (2003).

M. Usman, A. A. Zaidi, *Trace formulas for Schrödinger operators on star graphs with general matching conditions*. **Journal of Physics A: Mathematical and Theoretical**, 51, 365301 (2018).

Ali A Zaidi, Bruce VanBrunt, Graeme C Wake, *Probability density function solutions to a Bessel type pantograph equation*, **Applicable Analysis** Volume 95 Issue 11 Pages 2565-2577 (2016).

Ali A Zaidi, Bruce Van Brunt, Graeme Charles Wake, *Solutions to an advanced functional partial differential equation of the pantograph type*, **Proceedings of the Royal Society A: Mathematical, Physical, and Engineering Sciences**. Volume 471 Pages 20140947 (2015).



#### **STEFANO LUZZATTO**

IMM Coordinator, Mathematics Section, Abdus Salam International Centre for Theoretical Physics, Italy

"The International Mathematics Master (IMM) is run through a partnership between the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, and the Mathematics Department at LUMS, which has recently been awarded the prestigious titles of ICTP Affiliated Centre and of Emerging Regional Centre of Excellence (ERCE) by the European Mathematical Society. The IMM is a world-class 2-year Master Programme focusing on Fundamental Mathematics. It is a competitive and challenging programme aimed at the very best Pakistani and international students who are interested in pursuing advanced research in Mathematics, or mathematics-related topics, at an international level."





## YOUR JOURNEY BEGINS HERE!

### Admission Criteria for Local and International Students

Applicants must meet the minimum eligibility criteria to be considered for admission to the programme. Admission is purely merit-based.

### For the MS Math Programme in partnership with ICTP, admission criteria includes the following:

- Academic Record
- Performance in Admission Tests
- Application Review
- Interview Performance (if shortlisted)
- Letters of Recommendation
- Submission of complete Online Application and supporting documents by the stipulated deadline

Scan for more information



## For the PhD programme, admission criteria includes the following:

- Academic Record
- Performance in Admission Tests
- Application Review
- Research Statement
- Submission of complete online application, application processing fee and supporting documents by the stipulated deadline
- Letters of Recommendation
- Interview Performance (if shortlisted)

Scan for more information



## Admission Criteria for Phd Programme for Foreign Nationals

SBASSE's PhD application for foreign nationals caters to applicants who currently reside outside Pakistan and have a foreign nationality.

All other applicants (i.e. those who have dual nationality, are Pakistani nationals, or are overseas Pakistanis) are required to apply through the regular admission application.

Admission is purely merit-based and rests on the following criteria:

- Academic Background
- Research Background
- Online Test and Interview (if shortlisted)

In order to study at LUMS, foreign nationals must obtain a 'Study Visa' from the Pakistani Embassy/ Consulate working in their country. The Pakistani Embassy/Consulate will only issue a Study Visa for students' stay at LUMS upon receipt of Higher Education Commission (HEC), Pakistan's 'No Objection Certificate' and clearance from the Ministry of Interior, Pakistan.

For the issuance of Visa, students must submit relevant documents to the LUMS Admissions Office through postal mail/courier service by the stipulated deadline.

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## LUMS Graduate Programme Financial Support

Admission to all LUMS programmes is purely on merit and independent of students' ability to pay the related tuition fees. Once a student has been admitted to a programme, there are several mechanisms in place to provide financial support based on need and merit. All awards are reassessed each academic year based on performance, need, available resources and prevailing University policies. LUMS is committed to providing as much financial assistance as possible within the limits of its available resources. Nevertheless, the University may not be able to meet all requests for financial assistance, and it is strongly recommended that applicants secure as much of their own funding as possible. Several funding opportunities are available to deserving MS and PhD students. These include:

- Merit Scholarships
- Partial tuition fee waivers for MS Basic Sciences students
- LUMS Interest-free Loan that covers partial to full tuition fee expense (only for local applicants)
- External Scholarships (support and eligibility for these scholarships vary depending on the donor)
- Options to work as Research or Teaching Assistants (subject to availability)
- Full funding of the PhD, which covers tuition, registration, admission fee and a monthly stipend for 4 years.

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### **MUGHEES GHAYAS**

#### PhD Mathematics 2021

"The Department of Mathematics has excellent academic resources and the faculty is extremely friendly and approachable. The core courses requirement for the graduate programme ensures that students are exposed to the fundamental ideas underlying various areas of mathematics. Moreover, the John Conway seminar series allows students to interact with foreign faculty and explore new areas. From a researcher's perspective, the advisors are very passionate and they motivate and challenge the students."







DHA, LAHORE CANTT. 54792, LAHORE, PAKISTAN Ph: +92-42 111- 11- LUMS (5867) Ext: 2177 Email: admissions@lums.edu.pk Website: www.lums.edu.pk



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