

Abdus Salam School of Mathematical Sciences (ASSMS)

Introduction

The idea behind the Abdus Salam School of Mathematical Sciences (ASSMS) is to create a world-class doctoral research institute in mathematics, but rooted in a developing country like Pakistan. The goal is to provide a pool of highly trained indigenous scientists to universities of Pakistan that would be an asset to its future economic and technological development, a crucial factor for the much desired peace in the area.

It is a proud feature of its short history that since its inception in late 2003 until now, with 121 PhD graduates to its name, the ASSMS has already more than doubled the existing tally of university mathematics faculty at the doctoral level in Pakistan. The ASSMS takes its responsibility of disseminating to the Pakistani academic community the importance of a rich scientific and mathematical culture. For this task, a team of highly trained mathematicians specializing in a broad range of courses in Mathematics and Theoretical Physics from Europe, Britain and the US, many of whom are authorities in their fields, are invited as either visiting or regular faculty.

Recognition of ASSMS as an Emerging Regional Center of Excellence – 2011

The ASSMS was honored by being named one of three emerging regional centers of excellence by the European Mathematical Society. Besides its world-class versatile PhD programme, the efforts of ASSMS have been directed at the broader goals of faculty training, popularizing Math at school and college levels and serving as the quintessential centre for modern research in Pakistan.

Selection of ASSMS for International Advanced Level Workshops - 2012

UNESCO and the Abdus Salam International Centre for Theoretical Physics (ICTP) in collaboration with world-famous Centre International de Mathématiques Pures et Appliquées (CIMPA), choose every year only two centres of advanced studies from all over the world to fund the advanced level workshops. ASSMS was one of the two chosen centers in 2012. The resource persons and main speakers at this workshop was ASSMS faculty. UNESCO, ICTP and CIMPA invited young researchers from all over the world for learning from the faculty of the Pakistani centre, the ASSMS. These young researchers from different parts of the world received training at ASSMS to carry out the useful research in diverse areas of mathematical sciences. All the expenses of the foreign delegates coming to ASSMS are paid by UNESCO, CIMPA and ICTP. The selection of ASSMS by the world-class organizations, for carrying out high level research workshops to train the international scientific community is on one hand, recognition at the highest forum that ASSMS is a research centre of international standards. On the other hand, it also shows that the faculty at ASSMS is trusted and respected at the world forum.

Declaration of ASSMS as the Headquarter of NIM Centers – 2013

After the initial success of the EMS-ERCE scheme, a meeting was held in Paris in June' 2013 attended by representatives of all the ERCE member institutions, the EMS and the International Mathematical Union (IMU). The agenda of this meeting was the formation of a network, consisting initially of the EMS-ERCE members, and eventually allowing membership to other mathematical centers of excellence in developing countries

around the world. The name of this network is "NIM Centres" (Network of International Mathematical Centres). The ASSMS has been proposed the secretarial headquarter for the NIM Centres during the first two years.

Announced a Number of attractive Scholarships for Foreign Students to Study at ASSMS

European Mathematical Society (EMS) has announced a number of attractive scholarships for the foreign students to study at ASSMS. The EMS is one of the world's most prestigious societies. Award of such scholarships for students from other countries to study at ASSMS is definitely an open recognition of the fact that EMS considers the ASSMS as a top world-class institution for advanced studies and research in Mathematics. The EMS awards scholarships to the most talented students from all over the world for study at different centres of excellence around the globe. ASSMS is first Pakistani institution to be recognized at this level.

Admission Eligibility

- MSc in Mathematical Science or equivalent
- Four years BSc with major in Mathematics Following students are also eligible to apply
- Students waiting for the results of their final exam
- Students in the final semester of their MSc or 4 years BSc (Hons) programmes

Admission criteria is based upon past academic performance, admission test conducted by the School and the interview with an international committee of experts. The School will require exclusive time commitment from its students.

Fee Structure

The institution provides free of cost education to the students. The funding is being supported by Higher Education Commission (HEC) of Pakistan, Government of the Punjab, Government of Pakistan and other external sources.

Financial Support / Scholarship

The institution provides adequate financial assistance to its MPhil/PhD students.

Exclusive Time Commitment

- 1 Each student of the program has to be a full time student.
2. ASSMS student shall neither get admission in any other programme during his/her studies nor shall he/she undertake any employment unless specifically permitted by the Director General.

Programme Breakup

- Prior to the start of course work all students are required to take Graduate Assessment Test (GAT) - General conducted by National Testing Service (NTS) with a minimum cumulative score of 50%.
- Each student MUST successfully complete a course work recommended by Academic Committee of ASSMS with a CGPA of greater than 3.0
- After successfully completing the first year course work, students are required to write MPhil thesis in their second year. At the same time students must take additional course work of PhD level as recommended by the Academic Committee of ASSMS. The course work is always more than 18 credits. The course work is followed by a comprehensive examination.
- In case a student fails to perform at the required level, the Academic Committee may consider the case for the award of an MS degree subject to fulfilment of other requirements

of the degree. The Academic Committee can also recommend that the failed student may be dropped out of the programme.

- I Students must take Subject GRE International with minimum of 60 percentile.
- If a student is asked to take certain courses by the Academic Committee of ASSMS then student must pass all these courses. In case of failure the student may lose his/her enrolment in the programme.
- PhD dissertation must be evaluated by at least two experts from academically advanced countries.
- Acceptance/publication of at least one research paper in an web of knowledge journal is essential before the submission of PhD thesis.

MPhil/PhD		
Year-I		
Course Code	Course Title	Credit Hours
Math-7101	Linear Algebra	4
Math-7102	Algebra I	4
Math-7103	Algebra II	4
Math-7104	Geometry I	4
Math-7105	Geometry II	4
Math-7106	Real Analysis I	4
Math-7107	Real Analysis II	4
Math-7108	Complex Analysis	4
Math-7109	Number Theory	3
Math-7110	Differential Equations	4
Year-2		
Course Code	Course Title	Credit Hours
Math-8101	Homological Algebra	4
Math-8102	Partial Differential Equations	4
Math-8103	Probability Theory	4
Math-8104	Mathematical Aspects of Theoretical Physics	3
Math-8105	Numerical Analysis I	3
Math-8106	Functional Analysis	4
Math-8107	Commutative Algebra I	3
Math-8108	Computational Algebra I	3
Math-8109	Measure Theory	3
Math-8110	Multivariable Complex Analysis	3
Math-8111	Commutative Algebra II	3
Math-8112	Computational Algebra II	3
Math-8113	Calculus of Variations	2
Math-8114	Algebraic System Theory	4
Math-8115	Lie Groups and Algebras	4
Math-8116	Riemann Surfaces	2
Math-8117	Combinatorics	4
Math-8118	Graph Theory	4
Math-8119	Stochastic Processes	4
Math-8120	Algebraic Number Theory	3
Math-8121	Algebraic Topology	4
Math-8122	Algebraic Geometry	3
Math-8123	Algebraic Curves	3
Math-8124	Application of Group Theory to Physics	3
Math-8125	Chaotic Dynamical Systems	3
Math-8126	Classes of Rings and Modules	3
Math-8127	Convex Analysis & Nonlinear Optimization	3
Math-8128	Differential Geometry	3
Math-8129	Differential Topology	4

Course Code	Course Title	Credit Hours
Math-8130	Field & Galois Theory	3
Math-8131	Financial Mathematics	4
Math-8132	Fluid Mechanics	4
Math-8133	Introduction to Valuation Theory	3
Math-8134	Non-Linear Dynamics & Control Theory	3
Math-8135	Analytic Number Theory and Elliptic Curve	3
Math-8136	Convex Sets	2
Math-8137	Differential Inclusions and Fuzzy Differential Equations	4
Math-8138	Topics in Field Theory	3
Math-8139	IntInteracting Stochastics Systems	3
Math-8140	Graph Labelings	3
Math-8141	Interpolation Theory and Applications	4
Math-8142	Special Topics in Analysis	3
Math-8143	Statistical Models & Simulation I	3
Math-8144	Statistical Models & Simulation II	3
Math-8145	Distribution Theory	3
Math-8146	Numerical Analysis II	2
Math-8147	Approximation Theory in Real and Complex Domain	4
Math-8148	Combinatorial Geometry	3
Math-8149	Absolute Summing Operators	3
Math-8150	Advanced Quantum Statistical Mechanics	3
Math-8151	Special Topics in Complex Analysis	4
Math-8152	Gorenstein Rings	3
Math-8153	Convex Analysis	3
Math-8154	Local Cohomology	3
Math-8155	Multiplicative Ideal Theory	3
Math-8156	Applied Control Theory	3
Math-8157	Fuzzy Sets & Fuzzy Differential Equations	2
Math-8158	Dynamical Systems	3
Math-8159	Functional Differential Equations	4
Math-8160	Complex Analysis & Potential Theory	4
Math-8161	Arithmetical Rings	4
Math-8162	Differential Complex Geometry	3
Math-8163	Introduction to Manifolds	3
Math-8164	Serre's Problem on Projective Modules	3
Math-8165	Fuzzy Analysis Simple Calculus	3
Math-8166	Projective Modules and General Linear Group	3
Math-8167	Cryptography	3
Math-8168	Several Complex Variables	3
Math-8169	Fourier Series	3
Math-8170	Calculus on Manifolds	3
Math-8171	Finite Fields & Selected Topics	2
Math-8172	Distribution of Prime Numbers	2

Course Code	Course Title	Credit Hours
Math-8173	Introduction to Symplectic Geometry	3
Math-8174	Factorization in Integral Domains	3
Math-8175	Selected Topics in Combinatorics	2
Math-8176	Hyperbolic Geometry of Polyhedra and Manifolds	2
Math-8177	Operator Theory	3
Math-8178	Integral Equations	3

Thesis and its Evaluation

- Thesis is a compulsory requirement for the award of MPhil/PhD degree.
- PhD thesis can be submitted within five years of admission to the program. Permission of the supervisor(s) for submission of the thesis is must.
- The PhD thesis must make distinct contribution to the discipline and should provide an evidence of original research.
- During the period of PhD research, the supervisor has to give candidate's performance report to the Director General after every 6 months.
- An extension in the submission time of PhD thesis may be granted by the Director General on the recommendation of the supervisor up to a maximum duration of six months.
- The candidate has to submit seven copies of his typed thesis.
- The PhD thesis shall be examined by 2 referees appointed by the Vice Chancellor, GC University Lahore from a panel of 4 referees suggested by the Board of Studies, all of them, belonging to universities of academically developed countries. The supervisor(s) cannot be a part of this panel of 4 experts.
- The reports of the referees shall be scrutinized by the Academic Committee of the ASSMS. If the reports declare the thesis to be satisfactory and recommend for the award of PhD degree, the Controller shall inform the Board of Examiners (approved by the Board of Studies) about the time and date of the viva-voce Examination of the candidate to defend his/her thesis.
- The board for the viva-voce examination shall comprise of the Director General, one internal examiner, one external examiner and the supervisor(s) of the candidate.
- On satisfactory performance of the candidate in the viva-voce examination the Board of Examiners shall recommend to the Academic Committee of ASSMS for the award of the degree to the candidate.
- The accepted thesis, its formulation/invention of commercial interest shall become the property of the ASSMS, GC University Lahore.

Post-Doctoral Fellowship Programme

Before the existence of ASSMS, Pakistani Mathematicians used to go abroad for Post-Doctoral Fellowship. Now here at ASSMS things are happening other way round. Number of young PhD holders from prestigious institutions of the world are choosing ASSMS to do their Post-Doctoral research. This success of Post-Doctoral Fellowship Program speaks volumes about the quality of faculty at ASSMS.

Terms of Post-Doctoral Fellowship

The Board of Governors has defined the following criteria for the appointment of Pakistani and foreign scholars for the Post-Doctoral Fellowship program.

- The fellowship can be awarded for a period of 3 months to 2 years.
- A candidate seeking post-doctoral fellowship in a certain area of specialization at ASSMS, must be recommended by two well known experts in the area of specialization.

Research Groups/Research Strengths

Sr. No	Title of Research Group	Title of Research Group	Postgraduate Students
1.	Quantum Statistical Mechanics and Mathematical Modeling	Alexander Kondratyev	3
2.	Algebraic Geometry, Differential	Alexander Dimca, Barbu Berceanu, Oleg Mushkarov, Johann Davidov, Hong Van Le, Catalin Liviu Gherghe	15
3.	Geometry and Algebraic Topology	Ioan Tomescu, Edy Tri, Baskoro Sheng Bau, Martin Baca	14
4.	Graph Theory and Combinatorics	Malkhaz Shashiashvili	4
5.	Stochastic Process and Financial Mathematics	Alexander Meskhi, Gerogi E. Karadzhev	5
6.	Functional Analysis	Oleg I. Reinov	3
7.	Discrete Geometry	Tudor Zamfirescu	8
	Commutative Algebra	Dorin Popoescu, Juergen Herzog	
8.	Convex Analysis	Josip Pecaric Constantin,	9
9.	Differential Equations and Dynamical Systems	P. Niculescu Constantin Buse, Constantin Varsan	3
10.	Ring Theory	Tiberiu Dumitrescu, Cristodor Ionescu	3
11.	Fluid Mechanics	Constantin Fetecau, Vieru Dumitru	10
12.	Simulation Theory	Kartlos Kachiashvili	3
13.	Computational Algebra	Alexei Stepanov	6
14.	Group Theory	Alexei Stepanov	1
15.	Numerical Analysis	Calin-Ioan Gheorghiu	1
16.	Operator Theory	Dan George Timotin	1
17.	Fuzzy Systems	Vasile Lupulescu, Tzanko Donchev	3
18.	Approximation Theory and Complex Analysis	Rein Leo Zeinstra	2
19.	Control Theory and Nano Technology	Sergei Borisenok	3

1. Research Groups

GEOMETRY (Faculty including regular and visiting)

- Alexander Dimca
- Barbu Berceanu
- Oleg Mushkarov
- Johann Davidov
- Hong Van Le
- Catalin Liviu Gherghe
- Victor Vuletescu

This research group presently has 8 PhD students working in different areas of Geometry including Algebraic Geometry, Algebraic topology and Differential Geometry. In addition, 8 local faculty members from different universities of Pakistan are also part of this research group.

In the past four years, the group (together with their PhD students) has produced 86 research papers accepted for publication in international refereed journals; most of them are ISI journals.

Other activities

- Internal Seminars, Schools, Lecture Series: 84
- Intensive Courses Open to Public: 3
- International Exposures (Schools & Workshops): 5
- Professional Enhancement Trainings: 2
- **ALGEBRA** (Faculty including regular and visiting)
 - ✦ Gerhard Pfister
 - ✦ Peter Schenzel
 - ✦ Juergen Herzog
 - ✦ Dorin Popoescu
 - ✦ Cristodor Ionescu
 - ✦ Tiberiu Dumitrescu
 - ✦ Alexei Stepanov
 - ✦ Mircea Becheanu
 - ✦ Vakhtang Lomadze
 - ✦ Marius Vladioiu
 - ✦ Viviana Ene

The Algebra research group has 21 PhD students working in diverse branches of Algebra including Commutative Algebra, Computational Algebra, Rings and Modules, Homological Algebra and Algebraic Systems. Occasionally some young researchers from the countries in the region also join this research group as Post Doc Fellows. In addition, 8 local faculty members from different universities of Pakistan are also part of this research group.

In the past four years faculty, the Post Doc Fellows and PhD students together have written 141 research papers accepted for publication. Most of them were accepted in ISI journals.

- Internal Seminars, Schools, Lecture Series: 161
- Intensive Courses Open to Public: 2
- International Exposures (Schools & Workshops): 7
- Professional Enhancement Trainings: 3
- Analysis (Faculty including regular and visiting)
 - ✦ Josip Pečarić
 - ✦ Alexander Meskhi
 - ✦ Georgi E. Karadzhov
 - ✦ Oleg I. Reinov
 - ✦ Constantin Buse
 - ✦ Constantin Varsan
 - ✦ Dan George Timotin
 - ✦ Vasile Lupulescu
 - ✦ Tzanko Donhev
 - ✦ Constantin P. Niculescu
 - ✦ Marjan Praljak

The Analysis group along with 29 PhD students is involved in research areas including Convex Analysis, Operator Theory, Approximation Theory, Differential Equations, Dynamical Systems, Harmonic Analysis and Differential Inclusions. Several Post Doc. Fellows from the region are also associated with this group. In addition, 6 local faculty members from different universities of Pakistan are also part of this research group.

In the past four years, the group has produced 267 research articles accepted for publication mostly in ISI journals.

- Internal Seminars, Schools, Lecture Series: 89
- Intensive Courses Open to Public: 3
- International Exposures (Schools & Workshops): 4
- Professional Enhancement Trainings: 2

DISCRETE MATHEMATICS (Faculty including regular and visiting)

- ✦ Ioan Tomescu
- ✦ Tudor Zamfirescu
- ✦ Edy Tri Baskoro

- ✦ Martin Baca
- ✦ Liping Yuan

This group also has 9 PhD students. Their research work is in Graph Theory, Combinatorics and Discrete Geometry. Also 2 Post Doc. Fellows are working in these areas. In addition, 12 local faculty members from different universities of Pakistan are also part of this research group.

In the past four years, the group has produced 207 publications and most of these are in ISI journals.

- Internal Seminars, Schools, Lecture Series: 79
- Intensive Courses Open to Public: 2
- International Exposures (Schools & Workshops): 4
- Professional Enhancement Trainings: 2

APPLIED MATHEMATICS (Faculty including regular and visiting)

- ✦ Alexander Kondratyev
- ✦ Constantin Fetecau
- ✦ Calin-Ioan Gheorghiu
- ✦ Sergei Borisenok
- ✦ Vieru Dumitru

There are 11 PhD students working in this group. The Applied Mathematics group pursues research in areas of Quantum Statistical Mechanics, Fluid Dynamics, Control Theory and Numerical Analysis. In addition, 8 local faculty members from different universities of Pakistan are also part of this research group.

Since last four years, the faculty and PhD students at ASSMS have produced 151 research papers in areas of Applied Mathematics. Large majority of the papers were accepted for publication in ISI journals.

- Internal Seminars, Schools, Lecture Series: 49

STOCHASTIC PROCESSES (Faculty including regular and visiting)

- Anton Stefanescu
- Kartlos Kachiashvili
- Malkhaz Shashiashvili

This group has 4 PhD students and one Postdoctoral Fellow. PhD students are pursuing their research in areas of Stochastic Processes, Financial Mathematics and Simulation Problems. In addition, 2 local faculty members from different universities of Pakistan are also part of this research group.

In the past three years, faculty and students together have 31 research papers accepted for publication in well reputed international journals.

- Internal Seminars, Schools, Lecture Series: 21
- Number Theory (New group)
 - ✦ Michel Waldschmidt
 - ✦ Florian Luca
 - ✦ Francesco Pappalardi
 - ✦ Jorge Jiménez Urroz

This is a new group and they have not yet established any formal research program at ASSMS. The group has organized some intensive courses and has written one research paper together.

Facilities

- Computer Labs
- Membership of Math SciNet Portal

- MultiMedia
- Library for Advance Studies and Research

2. Special Features

World Conferences

The School regularly organizes world conferences on the theme "21 Century Mathematics". ASSMS also runs a large number of research seminars, workshops, schools, lecture series, colloquia, professional enhancement seminars and intensive courses for researchers and university faculty.

Students Research

PhD students are engaged in quality research and their papers are regularly published in the prestigious world class ISI journals. The research areas include different branches in Analysis, several fields in Algebra, Combinatorics, Graph Theory, Algebraic Geometry, Algebraic Topology, Differential Geometry, Mathematical Modeling, Fluid Mechanics, Control Theory, Stochastic Processes, Financial Mathematics, Dynamical Systems, Quantum Theory, Discrete and Computational Mathematics.

Communication Skills Training Programme

Oral and written communication skills are extremely valuable assets to do well in mathematics. ASSMS has introduced professional communication skills training program to increase the confidence level of its students and also to improve their ability to speak and write effectively.

Master Trainers

On the request of the Mathematical Community, ASSMS has started a series of intensive courses in some core areas of mathematics to train the national mathematics faculty. Generally these intensive courses are organized in areas where there is a very serious shortage of Pakistani experts.

Research Journal

ASSMS publish a quality research journal in Mathematical Sciences entitled "Journal of Prime Research in Mathematics" on regular basis. This is an HEC approved journal.



ASSMS has a complete team of well qualified scientists in all areas of mathematical sciences, both applied and pure. This team also includes experts in Mathematical modeling in the areas of environmental problems, bio sciences and industry related matters.

Steps Taken to Promote Mathematics in the Nation

ASSMS is taking some effective and P steps to promote and popularize mathematics in schools of Pakistan. In this direction, we have taken two concrete steps that are providing a much needed encouragement and incentive to Pakistani students in schools and colleges. They are:

1. The faculty at ASSMS regularly organize training Camps for students from schools and colleges. The participants of the camps are prepared and selected for national Team of Pakistan to compete at the International Mathematical Olympiad (IMO). In 2005, National Team of Pakistan took part for the first time in IMO and within a short span of two years, the Pakistani team went on to win the first medal at IMO 2007. ASSMS also started National Mathematics Olympiad (NMO). The school has hired foreign professors that have previously been coaches for international teams in Canada and Romania. These training Camps now prepare Pakistan's most brilliant students for international competition, IMO. These contests have sparked a good enthusiasm among the schools and colleges of Pakistan.
2. ASSMS has organized several mathematics contests at the national level. These contests have sparked a good enthusiasm among the schools and colleges of Pakistan.

Faculty

Department of ASSMS

Director General

Prof. Dr. G. Murtaza, SI

Salam Chair

National Distinguished Professor

Foreign Faculty

Dr. Tzanko Donchev

Dr. Dimitar Kolev

Dr. Johann Davidov

Dr. Viviana Ene

Dr. Martin Baca

Dr. Andrea Fenovcikova

Dr. Oleg I. Reynov

Dr. Gerhard Pfister

Dr. Ioan Tomescu

Dr. Constantin Fatecau

Dr. Dumitru Vieru

Dr. Tiberiu Dumitrescu

Dr. Vasile Lupulescu

Dr. Georgi E. Karadzhov

Dr. Cristodor Ionescu

Dr. Peter Schenzel

Dr. Renaud Leplaideur

Dr. Josip Pecaric

Dr. Evgenii Bashkirov

Dr. Rein Leo Zeinstra