SUKKUR IBA UNIVERSITY

DEPARTMENT OF MATHEMATICS AND SOCIAL SCIENCES

Scheme of Studies
For admission in

MS (Mathematics) and **PhD (Mathematics)** Programs

Brief Introduction of MS Program:

Sukkur IBA offers MS in Mathematics. The MS program in Mathematics prepares students for careers in research, applications and academia. The courses and research areas are designed so that students excel in following fields:

I. Mathematical Finance: Mathematical finance, also known as quantitative finance, is a field of applied mathematics, concerned with financial markets. Generally, mathematical finance will derive and extend the mathematical or numerical models without necessarily establishing a link to financial theory, taking observed market prices as input. Mathematical consistency is required, not compatibility with economic theory. Thus, for example, while a financial economist might study the structural reasons why a company may have a certain share price, a financial mathematician may take the share price as a given, and attempt to use stochastic calculus to obtain the corresponding value of derivatives of the stock. The fundamental theorem of arbitrage-free pricing is one of the key theorems in mathematical finance, while the Black–Scholes equation and formula are amongst the key results. Mathematical finance also overlaps heavily with the fields of computational finance and financial engineering. The latter focuses on applications and modeling, often by help of stochastic asset models, while the former focuses, in addition to analysis, on building tools of implementation for the models. In general, there exist two separate branches of finance that require advanced quantitative techniques: derivatives pricing on the one hand, and risk- and portfolio management on the other.

II. Abstract Algebra: Algebra is a fundamental and universal language upon which most other branches of mathematics are built. In recent decades, algebra has become an increasingly important field of study due to its numerous contemporary applications in physics, chemistry, computer science, data communication and security. Semigroups, groups and rings are abstract algebraic structures and are very important in theoretical computer science, crystallography, quantum physics and cryptography.

III. Fluid Mechanics: Fluid mechanics is the branch of physics that studies the mechanics of fluids (liquids, gases, and plasmas) and the forces on them. Fluid mechanics has a wide range of applications, including for mechanical engineering, chemical engineering, geophysics, astrophysics, and biology. Fluid mechanics can be divided into fluid statics, the study of fluids at rest; and fluid dynamics, the study of the effect of forces on fluid motion. Fluid mechanics, especially fluid dynamics, is an active field of research with many problems that are partly or wholly unsolved. Fluid mechanics can be mathematically complex, and can best be solved by numerical methods, typically using computers. A modern discipline, called computational fluid dynamics (CFD), is devoted to this approach to solving fluid mechanics problems.

IV. Computational Mathematics: The mathematical models in physics, geology, astrophysics, mechanics, geophysics, as well as in most engineering disciplines often involve nonlinear differential equations and complex geometric constraints. Besides the applications of such models, one must understand the solution approaches to such systems. It demands an in-depth knowledge of numerical methods, computer simulation and software design. The field of computational

mathematics addresses these aspects. It enables the students to equip with tools and skills to formulate numerical methods for the solution of system of differential equations and produce associated running algorithms. The course can be divided into basic and advanced level. Also the mathematical models include stationary, unsteady, deterministic and stochastic as well. The advanced level topics may include the uncertainty quantification and data assimilation procedures.

1. Program Goals

The goals and objectives of the MS Mathematics are as follows:

1. To foster excellence in mathematical research foundation and to offer a strong graduate education that will prepare students for their PhD studies.
2. To develop a level of quantitative literacy and analytical skills among the students in order to enable them to deal effectively with the quantitative issues that they will encounter throughout their lives.
3. To develop competence in those areas most relevant to the scholarly and professional objectives of the students.
4. To make students able to use technology, including specialized computational and graphics software in order to test the validity of certain conjectures, to solve problems, to conduct mathematical experiments and do mathematical research.
5. To make students able to effectively disseminate mathematical knowledge and understanding orally, in writing, or by other means.

2. Eligibility Criteria

1. Applicant must have (BS/MSc in Mathematics or 16 Years of Education in relevant field) with at least 1st Division or 2.2 CGPA from any HEC recognized University / Institution.
2. Applicant should have passed the NTS (GAT-General test) with a minimum of 50% cumulative score. A test equivalent to GRE (General and Subjective) is to be taken by the applicant for admission into MS degree. The test will be organized by the Sukkur IBA. Those applicants who qualify test will appear for the interview.

Please see the HEC Minimum Criteria for more detail or follow the link below: http://hec.gov.pk/english/scholarshipsgrants/Documents/MPHIL_Phd_Criteria.pdf

3. Distribution of Total Credit Hours

Category of Area	**Credit Hours**
Core Courses	18

Elective Courses	06
Thesis	06
Total Credit Hours	**30**

3.1 Roadmap of the Program

Students are required to successfully qualify eight courses each of 3 credit hours' duration. On successful completion of MS course work students will be allowed to work on a 06 credit hour thesis on a subject of interest and on the availability of the faculty. The minimum duration of completion of MS Program is 2 years (Four Semesters) and maximum duration is 4 Years and students must pass GAT (General) before applying for the admission.

3.2 Semester-wise Plan

SEMESTER - I			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.		Elective: To be selected from list of approved courses	03
2.		Elective: To be selected from list of approved courses	03
3.		Elective: To be selected from list of approved courses	03
Total Credit Hours			09

SEMESTER - II			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.		Elective: To be selected from list of approved courses	03
2.		Elective: To be selected from list of approved courses	03
3.		Elective: To be selected from list of approved courses	03
4.	ENG-601	Scientific Report Writing	00
Total Credit Hours			09

SEMESTER - III			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.		Elective: To be selected from list of approved courses	03
2.		Elective: To be selected from list of approved courses	03
3.	MATH-651	Research Proposal Defense (Discussion with Supervisor and Literature review)	00
Total Credit Hours			06

SEMESTER - III			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-651	Submission of Thesis + Final defense	06
Total Credit Hours			06

Brief Introduction of PhD Program:

In many disciplines, mathematics plays an extremely important role: ranging from stochastic analysis and models of large scale systems and networks, financial mathematics, statistical models, fluid dynamics computations, and risk assessment. Mathematical research, in general, contributes indirectly by supporting the advanced research in a variety of other discipline offered at Sukkur IBA University.

Department of Mathematics offers several courses for the students, such as Calculus, Linear Algebra, Analysis, Mathematical Modeling, Probability Theory, Mathematical finance and Statistics, Discrete Mathematics, and Stochastic processes. The offered coursework is designed to provide basic as well as advance training for the tools of applied mathematics, including numerical methods, ordinary, partial and stochastic differential equations and scientific computing. The courses offered build a solid mathematical background of the students, to further pursue with their doctoral research/degree. The graduate program open opportunity for the students interested in multidisciplinary mathematics projects for their PhD research in the fields of Mathematics.

Sukkur IBA University has about 17 faculty members working in different areas of Mathematics. Mathematics department is offering PhD courses, which are taught by our HEC recognized PhD

faculty. The PhD course contents are also designed such that students can improve and enhance their fundamental knowledge which is required to conduct doctoral research in their area of interest. The offered PhD coursework is designed, specifically, to choose from the following research areas of the available faculty members:

I. Stochastic Analysis and Finance
II. Abstract Algebra
III. Fluid Mechanics
IV. Computational Fluid Dynamics

4. Program Goals

The objectives of our PhD program in Mathematics are as follows:

1. Provide training for the development of the research capabilities in mathematics.
2. Building strong foundation in mathematical analysis and its real world applications.
3. Extending the mathematical thinking and proficiency beyond master level.
4. Contributing in the development of new emerging fields in applied mathematics as well as managing the complex interdisciplinary projects.
5. Becoming active in conducting the quality research with professional and ethical integrity.
6. Develop highly trained mathematician who can explore and address the mathematical needs in other sciences, industry and community.

5. Entry Requirement of the Program

The students eligible for admittance in PhD program should have the following:

1. MS/MPhil degree with a minimum CGPA 3.0 (out of 4.0 in semester system) or first division (in the annual system).
2. A subject test conducted by the National Testing Service (NTS) or ETS, USA in the area of specialization chosen at the PhD level must be cleared prior to admission for the PhD Program.

    a. In case of GAT subject or GRE subject test, the minimum required score is 60% marks.
    b. In case of STS, conducted by Sukkur IBA University, the minimum required score is 70% marks.

Please see the HEC Minimum Criteria for more detail or follow the link below:
http://hec.gov.pk/english/scholarshipsgrants/Documents/MPHIL_Phd_Criteria.pdf

6. Distribution of Total Credit ours

Category of Area	Credit Hours

Courses	18
Thesis	42
Total Credit Hours	**60**

6.1. Roadmap of the Program

As per HEC criteria the minimum and maximum duration to complete Ph.D. is three and six years respectively. The students are required to complete their course work and pass the comprehensive exam within first two years after registering into the program.

7. List of Elective Courses

Note: These Elective Courses will be offered on the availability of course instructors and the number of students registered for the course.

STOCHASTIC ANALYSIS AND FINANCE			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-601	Discrete Time Modelling and Derivative Securities	03
2.	MATH-602	Modeling of Bonds, Term Structure, and Interest Rate Derivatives	03
3.	MATH-603	Stochastic Calculus & Black-Scholes Theory	03
4.	MATH-604	Continuous Time Finance/Market and Interest Rate Modeling	03
5.	MATH-605	Credit Risk modeling	03
6.	MATH-606	Mathematical Methods for Finance	03
7.	MATH-607	Numerical Solution of Stochastic Differential Equations	03
8.	MATH-608	Stochastic Partial Differential Equations	03
9.	MATH-609	Actuarial mathematics	03
10.	MATH-610	Measure and Integration	03
11.	MATH-611	Stochastic Processes	03

FLUID MECHANICS			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-621	Fluid Mechanics	03
2.	MATH-622	Viscous Fluids	03
3.	MATH-623	Non-Newtonian Fluids	03
4.	MATH-624	Theory of Fluids	03
5.	MATH-625	Methods of Applied Mathematics	03
6.	MATH-626	Perturbation Methods	03
7.	MATH-627	Theory of Differential Equations	03

ABSTRACT ALGEBRA			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-631	Theory of group actions and group graphs	03
2.	MATH-632	Homological Algebra	03
3.	MATH-633	Error Correction and Coding Theory	03
4.	MATH-634	Theory of Semigroups	03
5.	MATH-635	Universal Algebra	03
6.	MATH-636	Category Theory	03
7.	MATH-637	Inverse Semigroups: The theory of Partial Symmetries	03

COMPUTATIONAL FLUID DYNAMICS			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-641	Computational Methods in Fluid Dynamics	03
2.	MATH-642	Numerical Methods for Partial Differential Equations	03

3.	MATH-643	PDE-Constraint Optimization	03
4.	MATH-644	Finite element methods for turbulent flows	03
5.	MATH-645	Transport Modelling	03

MS THESIS			
S. No.	**Course Code**	**Course Title**	**Credit Hours**
1.	MATH-651	MS Thesis	06

8. Policy Regarding MS Thesis:

- Maximum duration for submission of the thesis proposal and getting approved by the Doctoral Committee is three months from the date of registration.
- Minimum duration for thesis completion is 6 months and maximum duration is 12 months. In case of exceed, the candidate will have to get approval from the Doctoral Committee and he/she will have to pay fees also.
- Thesis is a compulsory requirement for MS degree.
- Supervisor has to give candidate's performance report to HEC after every 6 months.
- The thesis shall be examined by 2 referees appointed by the Director and Dean, SIBA from a panel of 5 referees suggested by the supervisor(s).
- The reports of the referees shall be scrutinized by the Academic Committee of the SIBA. If the reports declare the thesis to be satisfactory and recommend for the award of MS degree, the Director & Dean, SIBA shall appoint a Board of Examiners for the viva-voce Examination of the candidate to defend his/her thesis.
- The board for the viva-voce examination shall comprise of the Director and Dean, SIBA, one internal examiner, one External examiner and the supervisor(s) of the candidate.
- On the satisfactory performance of the candidate in the viva-voce examination the Board of Examiners shall recommend to the Academic Committee of SIBA for the award of the degree to the candidate.

The accepted thesis, its formulation/ invention of commercial interest shall become the property of the SIBAU.