

1 MSc in Mathematics Program

1.1 Mission

There is no doubt that the creation of the causes and means of scientific research, and the opening of the horizons of postgraduate studies to the ambitious interested have become necessary and sorely required by the current situation. Hence, the establishment of the Master of Science in Mathematics program at King Khalid University to achieve these noble civilizational goals.

Graduating students possessing thorough understanding of mathematical concepts, theories, research, and recent developments of mathematics by providing an integrated academic environment and research addressing the needs of community and bolstering economy of knowledge.

1.2 Goals

- Possession of a profound background in the foundations of graduate-level mathematical analysis, abstract algebra, statistics, and applied mathematics.
- Prepare high ranking specialists in research and education who will be capable to solve career challenges in various fields of life represented in the national institutes.
- Development of critical thinking and ability to synthesize different mathematical concepts to obtain definite conclusions for mathematical problems.
- Prepare students academically to continue their PhD studies locally or abroad.
- Obtainment of solid theoretical and practical knowledge in a particular field of study.
- Ability to conduct a research project and effectively communicate its findings to the research community.
- Practice of essential academic attributes, such as: self-learning, independence, responsibility, professional ethics, intuition, and pro-activity.

1.3 Graduate Attributes

Graduate attributes for which MSc in Mathematics students are prepared are as follows:

- Profound background in postgraduate level mathematics.
- Use appropriate knowledge and skills to identify, formulate, analyze, and solve complex scientific problems.
- Work effectively either independently or as a member of a team.
- Communicate complex mathematical concepts within the community and with society at large.
- Apply professional ethics, accountability, and equity.
- Able to identify and address his own educational needs to maintain competence for

adapting to new needs and environment.

1.4 Student Admission

The department of Mathematics is committed to the Unified Regulations of Postgraduate Studies at Saudi Universities and its Executive Regulations at King Khalid University. And especially, Article 15 for the entrance exam, and Article 18 for the complementary courses. Particularly, the department requires:

- Applicant must have a bachelor's degree in mathematics from a local university, college of ministry of education, or other institutes that are recognized by the Ministry of Education.
- Proficiency in English verified through one of the following:

Test	TOEFL-IBT	STEP	IELTS
Required level	45	67	4

or another equivalent program approved by a Saudi governmental university.

- Passing tests and personal interview conducted by the department.

If needed, all complementary courses that will be proposed must be passed with a grade of C or higher.

1.5 Program Learning Outcomes

Knowledge and understanding	
K1	Advanced knowledge and understanding that covers theories, principles, and concepts in mathematics.
K2	Write critical awareness of techniques, practices, conventions and/or terminology relevant to mathematics.
K3	List advanced knowledge and understanding of recent development in mathematics.
Skills	
S1	Apply specialized theories, principles, and concepts to solve problems in complex and advanced contexts, in mathematics.
S2	Assess, objectively analyze, and focus on the key ideas, values, and theories; and offer innovative solutions to current issues and problems in diverse and advanced contexts in mathematics.
S3	Carry out advanced research using specialized techniques of research and enquiry in mathematics.
S4	Use quantitative and/or qualitative methods to process data and information in complex and advanced contexts, related to mathematics.
S5	Communicate in various forms to disseminate knowledge, skills, research results related to mathematics.
S6	Identify, select, plan for (including resource planning), use and evaluate ICT applications and strategies to enhance the achievement of aims and desired outcomes.
Values	
V1	Work effectively, both independently and as part of an interdisciplinary group.
V2	Take full responsibility for initiating, identifying, amending, and achieving aims and desired outcomes, using new skills/ techniques as required.
V3	Able to articulate awareness of and demonstrate personal characteristics that positively impact the workplace and reflect integrity and professional and academic values when dealing with various issues.

1.6 Teaching and Learning Strategies to Achieve Program Learning Outcomes

Lectures, up-to-date textbooks, hand-outs, skills in using library and other learning resources, working groups, presentations, feedback, assignments, structured experiences in groups.

1.7 Thesis and its Requirements

1.7.1 Registration of the thesis:

The subject and content of the research thesis depend on many factors such as the student's interests, abilities, skills, and courses the student successfully passed. The student writes a master's thesis in a specific subject in mathematics under the direct supervision of a department faculty member after the approval by the Department's Postgraduate Studies Committee.

The process starts at level 3 with the special course 6901MATH-2. The student and his advisor choose a topic and propose a research plan to a committee of two experts from the departments, after approval from the Department's Postgraduate Studies Committee. The student elaborates his research thesis during the 4th level (can be extended upon approval of the Department's Postgraduate Studies Committee).

1.7.2 Scientific Supervision:

- Weekly regular meeting between the student and his/her supervisor.
- The supervisor advises the student periodically via blackboard and other technological means to:
 - ✚ Prepare and apply a research project according to scientific principles and research practices.
 - ✚ Learning mechanisms of scientific methods in data collection.
 - ✚ Learning scientific methods in data analysis and writing results.
 - ✚ Use of computers, internet, and ability to choose the best.
 - ✚ Ability to write a research strategy plan.
 - ✚ Self-learning and individual work.
 - ✚ Communication and interaction with others.
 - ✚ Ability to write research papers and reports.
 - ✚ Presenting results in writing and orally.

1.7.3 Thesis Defense:

As approved by the Department's Postgraduate Studies Committee:

- Student writes the research thesis and provides the thesis defense committee with copies.
- The student gives a seminar, and the thesis can be evaluated by the supervisor and two examiners.

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1.8 Study Plan

Course Code	Course Title	Prerequisite Courses	Credit Hours
Level 1			
Mandatory			
6221MATH-3	Measure Theory		3
6421MATH-3	Abstract Algebra		3
6621MATH-3	Partial Differential Equations		3
Total credit hours			9
Level 2			
Mandatory			
6301STAT-3	Probability Theory	6221MATH-3	3
6203MATH-3	Functional Analysis	6221MATH-3	3
6423MATH-3	Linear Algebra		3
Total credit hours			9
Level 3			
Mandatory			
6901MATH-2	Special Course	Department Approval	2
■ Elective (two courses are chosen according to the specialty track after department's council approval)			
6302STAT-3	Mathematical Statistics	6301STAT-3	3
6303STAT-3	Special Topics in Statistics and Probability	6301STAT-3	3
6204MATH-3	Special Topics in Analysis	6203MATH-3	3
6405MATH-3	Rings and Fields	6421MATH-3	3
6406MATH-3	Special Topics in Algebra	6421MATH-3 6423MATH-3	3
6603MATH-3	Numerical Analysis	6621MATH-3	3
6604MATH-3	Special Topics in Applied Mathematics	6621MATH-3 6423MATH-3	3

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6701MATH-3	Topology		3
Total credit hours			8
Level 4			
Mandatory			
6902MATH-6	Scientific Thesis		6
Total credit hours			6

Total credit hours for completing the program: 32 Hours.

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2 Program Courses Short Description

2-1 Compulsory Courses

Level 1					
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
1	6221MATH-3	Measure Theory		3	1/1
	Course General Description				
	<p>This course provides the essential foundations of measure theory and integration. Measure theory found numerous applications in the theory of differential equations, functional analysis, and fractal geometry; it is used to give a mathematical foundation to probability theory and statistics. It gives a natural extension of the Riemann integral which allows for better understanding of the fundamental relations between differentiation and integration.</p>				
	Essential References				
	<ul style="list-style-type: none"> • Donald L. Cohen. Measure Theory, Second Edition. Birkhauser, 2013. • B. Folland, Real Analysis: Modern Techniques and Their Applications, Wiley, 2nd Ed. (2007). 				
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
1	6421MATH-3	Abstract Algebra		3	1/1
	Course General Description				
	<p>This course will cover some fundamental concepts, ideas, properties, and theorems of group theory. The basic topics in group theory that this course will focus on are: Binary operations, elementary properties of groups, cyclic groups, symmetric groups, subgroups, quotient groups, Lagrange's Theorem, Composition series and Solvable groups. As well as, the basic homomorphism theorems, group actions and their consequences like Cayley's Theorem and the Class Equation Theorem, p-subgroups, and Sylow's Theorems and their applications.</p>				
	Essential References				
	<ul style="list-style-type: none"> ▪ D. Dummit and R. Foote, Abstract Algebra, 3rd Edition, Prentice Hall 2004. 				

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	<ul style="list-style-type: none"> ▪ J. Rotman, Advanced Modern Algebra, 2nd AMS 2010. 				
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
1	6621MATH-3	Partial Differential Equations		3	1/1
	Course general Description				
	<p>Mandatory course devoted to the basis of Partial Differential Equations. It presents the Fundamentals of partial differential equations and some important solving methods. Also, existence and uniqueness theory and properties of solutions are discussed.</p>				
	Essential References				
<ul style="list-style-type: none"> ▪ E. Zachmanoglou and D. Thoe, “Introduction to Partial Differential Equations with Applications”, Dover, 1986. ▪ H. Brezis, “Functional Analysis, Sobolev spaces and Partial Differential Equations”, Springer, 2011. 					
Level 2					
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
2	6203MATH-3	Functional Analysis	6221MATH-3	3	2/1
	Course general Description				
	<p>This course provides the essential foundations of functional analysis which plays an increasing role in the applied and pure mathematics. Essentially, a review of the theory of metric spaces, Banach spaces and linear operators will be investigated. That allows to develop some key theorems of functional analysis.</p>				
	Essential References				
<ul style="list-style-type: none"> ▪ E. Kreyszig, Introductory Functional Analysis with Applications, 1st Ed., Wiley (1989). ▪ W. Rudin, Functional Analysis, 2nd Ed., McGraw Hill (1991). 					
Level	Course Code	Course Tit	Prerequisite Courses	Credit Hours	Level/year
2	6301MATH-3	Probability Theory	6221MATH-3	3	2/1
	Course general Description				
<p>The probability theory plays an important role in various researcher areas such as</p>					

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	<p>telecommunications, mathematical finance, statistical physics, and many others. This course presents the fundamentals of probability theory and random processes. Topics include axiomatic probability theory; discrete and continuous random variables; functions of random variables; generating functions and transform methods; inequalities, bounds and large deviation theory; convergence and limit theorems; random processes; spectral representation.</p>				
	Essential References				
	<ul style="list-style-type: none"> ▪ R. Durrett, <i>Probability: Theory and Examples</i>, Duxbury Press, 1996. ▪ R. Dudley, <i>Real Analysis and Probability</i>, Chapman and Hall, 1994. 				
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
	6423MATH-3	Linear Algebra		3	2/1
	Course general Description				
2	<p>In this course, we assimilate the basic concepts of vector spaces and subspaces, eigenvalues and eigenvectors, linear transformations, and dual spaces. Inner product spaces, orthogonal and orthonormal bases, unitary, Hermitian, and normal matrices will be also deeply studied.</p>				
	Essential References				
	<ul style="list-style-type: none"> ▪ S. Friedberg, A. Insel, L. Spence, <i>Linear Algebra</i>, 5th Ed., 2018, Pearson. ▪ K. Hoffman, R. Kunze, <i>Linear Algebra</i>, 2nd Ed., 1973, Prentice-Hall. 				
Level 3					
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
	6901MATH-3	Special Course		2	3/2
	Course general Description				
3	<p>This course aims to provide individual student with knowledge and understanding of research methods and training in a special topic in mathematics that will help to accomplish the research project in the thesis. The course provides student with scientific research skills and transferable skills such as mathematical software, communication, self-management to plan and prepare a defendable research proposal for a specific topic in mathematics. Given the diversity of research interests and the tracks of the program, the department will assign an advisor for each student. Student should prepare and defend a research proposal and demonstrate deep understanding of the material relevant to the selected mathematical topic.</p>				

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Essential References					
<ul style="list-style-type: none"> ▪ References will be fixed according to the chosen topics. 					
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
3	6*** MATH-3	Elective Course 1		3	3/2
	Course general Description				
	See Section 2.2 below for a complete list of Elective Courses.				
	Essential References				
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
3	6*** MATH-3	Elective Course 2		3	3/2
	Course general Description				
	See Section 2.2 for a complete list of Elective Courses.				
	Essential References				
Level 4					
Level	Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
4	6902MATH-6	Thesis		6	4/2
	Course general Description				
	<p>A mandatory requirement for obtaining a Master of Science degree in Mathematics. Student submits for passing a specialized scientific thesis that is original and innovative in one of the research topics previously approved by Postgraduate Studies Committees. The department appoints a supervisor for the student's thesis, so that during the thesis preparation period, the professor will carefully supervise the thesis. Student ends up successfully passing a scientific discussion of the thesis by a specialized committee approved by Postgraduate Studies Committees determined by the relevant regulations.</p>				
	Essential References				
<ul style="list-style-type: none"> ▪ References will be fixed according to the Thesis Subject. 					

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2-2 Elective Courses

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6204MATH-3	Special Topics in Analysis	6203MATH-3	3	3/2
Course General Description				
<p>This is an elective course, which studies a selected advanced topic (or more than one topic) in Analysis and its applications. The topics are to be determined by the department's Analysis committee upon approval of the Postgraduate Studies Committee. The approval of the department's council is also required.</p>				
Essential References				
<ul style="list-style-type: none"> ▪ References will be fixed according to the chosen topics. 				
Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6302STAT-3	Mathematical Statistics	6301MATH-3	3	3/2
Course General Description				
<p>The main object of inferential statistics is to reconstruct an unknown characteristic of a population from a finite sample of this population. This issue allows to provide decision mechanisms in various domains such as commerce, economics, environ metrics, finance, security, reliability, among other. The aim of this course is to acquaint the students with the fundamentals of the theory and practice of the statistical inferences.</p>				
Essential References				
<ul style="list-style-type: none"> ▪ T. Ferguson. " Mathematical Statistics: A decision theoretic Approach", Academic Press. 1969. ▪ E. Lehmmann. " Theory of Point Estimation", Springer, 1995. 				
Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6303STAT-3	Special Topics in Statistics and Probability.	6301STAT-3	3	3/2
Course General Description				
<p>This is an elective course, which studies a selected advanced topic (or more than one topic) in Probability and/or Statistics and their applications. The topics are to be determined by the department's Probability and Statistics committee upon approval of the Postgraduate Studies Committee. The approval of the department's council is also required.</p>				

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Essential References

- References will be fixed according to the chosen topics.

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6405MATH-3	Rings and Fields	6421MATH-3	3	3/2

Course General Description

This course is devoted to basics of rings and fields. More specifically, the topics to be covered include ideals and quotient rings, integral domains, PIDs, UFDs, rings of polynomials, field extensions (algebraic, separable, normal, transcendental), as well as Galois groups.

Essential References

- D. Dummit and R. Foote, Abstract Algebra, 3rd Edition, Prentice Hall, 2004.
- T. Hungerford, Algebra, 1st Ed., Springer, 2003.

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6406MATH-3	Special Topics in Algebra	6423MATH-3 6421MATH-3	3	3/2

Course General Description

This is an elective course, which studies a selected advanced topic (or more than one topic) in Algebra and/or Number Theory and their applications. The topics are to be determined by the department's Algebra committee upon approval of the Postgraduate Studies Committee. The approval of the department's council is also required.

Essential References

- References will be fixed according to the chosen topics.

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6603MATH-3	Numerical Analysis	6621MATH-3	3	3/2

Course General Description

Elective course devoted to basics of classical numerical methods and numerical integration. It presents the problem of numerical approximation of mathematical problems, both from the theoretical and methodological (algorithms) point of view. Students will use MATLAB software to study specific problems numerically.

Essential References

- J. Epperson, An Introduction to Numerical Methods and Analysis, Revised Ed.,

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Wiley, 2007.

- K. Atkinson, An Introduction to Numerical Analysis, 2nd Ed., Wiley, 1989.

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6604MATH-3	Special Topics in Applied Mathematics	6621MATH-3 6423MATH-3	3	3/2

Course General Description

This is an elective course, which studies a selected advanced topic (or more than one topic) in Applied Mathematics. The topics are to be determined by the department's Applied Mathematics committee upon approval of the Postgraduate Studies Committee. The approval of the department's council is also required.

Essential References

- References will be fixed according to the chosen topics.

Course Code	Course Title	Prerequisite Courses	Credit Hours	Level/year
6701MATH-3	Topology		3	3/2

Course General Description

This course provides the essential of point set topology treated in a profound fashion. It is designed to provide student with an intense foundation in fundamental concepts of point-set topology. The student will be familiar with basic problems in topological space, Metric Spaces. Further with connectedness, compactness, density, basis, compactification, and fundamental group.

Essential References

- J. Munkres, Topology, 2nd Ed., Prentice Hall (2000).