Master of Science in Mathematics
Program code: 041010

INTRODUCTION

The Department of Mathematics offers a graduate program that leads to Master of Science degree in **Mathematics**. The Program features a thesis and non-thesis option. The thesis option requires a successful conclusion of a thesis, and the non-thesis option requires the completion of a project. Passing a comprehensive examination is required for students who choose a non-thesis option. English is the Language of instruction and research.

According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.

PROGRAM REQUIREMENTS (non-thesis option in parenthesis)

30 (33) TOTAL COURSE CREDITS

3 (6) COMPULSORY COURSES (3 credits each)

0410-510 Analysis I
0410-593 Project (for non-thesis option only)

6-12 (6-12) BASIC COURSES (3 credits each)

The student must take at least two courses from the following courses:

0410-501 Algebra
0410-512 Complex Analysis I
0410-513 Ordinary Differential Equations
0410-525 General Topology

6-12 (15-21)ELECTIVES* (3 credits each)

0410-508 Topics in Algebra
0410-515 Functional Analysis
0410-517 Special Functions
0410-520 Boundary value Problems
0410-521 Variational Methods and Eigen value Problems
0410-522 Financial Mathematics Modeling & Computation
0410-523 Topics in Applied Mathematics
0410-526 Algebraic Topology
0410-530 Foundations of Geometry
0410-531 Differentiable Manifolds
0410-532 Topics in Differential Equations
0410-535 Graphs and Hyper Graphs

0410-537 Combinatorics
0410-542 Scientific Computing Mathematical Models And Algorithms
0410-543 Advanced Numerical Computing
0410-560 Numerical Solution of ODE's
0410-561 Computational Linear Algebra
0410-568 Topics in Numerical Mathematics

*With the approval of the Program Director, the student can substitute up to (6) credit hours from 500-level courses from other graduate programs or 400-level courses from the undergraduate program in mathematics at Kuwait University for courses in the elective list.

9 COMPULSORY COURSES

0410-597 Thesis (0)
0410-598 Thesis (0)
2000-599 Thesis (9)

COURSE DESCRIPTION

0410-501: ALGEBRA
CR: 3
Fundamental topics on groups including semi groups; Groups; subgroups; abelian groups; direct groups; groups of permutations; cyclic groups; normal subgroups; quotient groups; homomorphisms and isomorphisms; group actions; orbits; lagrange's theorem; p-groups; the sylow theorems; the basis theorem; the fundamental theorem of finite abelian groups.

0410-508: TOPICS IN ALGEBRA
CR: 3
Topics may differ from time to time, the course may be repeated for credit provided the topics are different.

0410-510: ANALYSIS I
CR: 3
Riemann-Stieltjes integral, uniform convergence of sequences and series of functions; functions of several real variables; and the lebesgue integration.

0410-512: COMPLEX ANALYSIS I
CR: 3
Analytic, Cauchy's integral formula, residues. Infinite product. Conformal mapping.Riemann mapping theorem.

0410-513: ORDINARY DIFFERENTIAL EQUATIONS
CR: 3
Existence and uniqueness of solutions to initial value problems in n-dimensions.
Continuation (extendibility) of solutions and continuity with respect to initial conditions and parameters. Stability theory, linearization and Lyapunov methods. Sturmian theory and self-adjoint boundary value problems.

0410-515: FUNCTIONAL ANALYSIS
CR: 3
Metric spaces; normed vector spaces; inner product spaces; ip spaces; topology of a metric space; complete metric spaces; banach spaces (Ip and C[a,b]); Hilbert spaces; completion of a metric space (Lp[a,b]); finite dimensional normed vector spaces; linear operators; linear functional; normed spaces of operators; dual spaces; functional on Hilbert spaces; self-ad joint, unitary, and normal

operators; Hahn-banach theorem; uniform boundedness theorem; open mapping theorem; closed graph theorem.

0410-517: SPECIAL FUNCTIONS
CR: 3

Asymptotic expansions. Bessel functions and related functions, hypergeometric, confluent hypergeometric and generalized hypergeometric functions. Jacobi polynomials, Meijer's G-functions.

0410-520: BOUNDARY VALUE PROBLEMS
CR: 3

Partial differential equations of mathematical physics and engineering, the well posed problem, Dirichlet, Neumann and the mixed problems, methods of solution, Green's function, integral equations, integral transforms.

0410-521: VARIATIONAL METHODS AND EIGEN VALUE PROBLEMS
CR: 3

Laplace's equation fundamental solution, mean-value property, properties of harmonic functions(max/min principles, harmonic estimate, analyticity Liouville's theorem), Green's functions, Dirichlet principle, weak derivatives; introduction to sobolev theory; existence of weak solutions of various linear elliptic PDEs; Dirichlet principle in sobolev space Eigenvalue problems; introduction to variational principles related to the heat and wave equations.

0410-522: FINANCIAL MATHEMATICS – MODELING & COMPUTATON
CR: 3

'Finance' is one of the fastest developing areas in the modern banking and corporate world. This, together with the sophistication of modern financial products, provides a rapidly growing impetus for new mathematical models and modern mathematical methods. The course describes the modeling of financial derivative products, through analysis to elementary computaton. Topics include: basic option theory, tree models, continuous time models and Black-Scholes, analytic approach to Black-Scholes, hedging numerical and binomial methods, bonds and interest rate derivatives models, computational methods for bonds, further theory of exotic and path-dependent options, foreign currency markets and exchange risks.

0410-523: TOPICS IN APPLIED MATHEMATICS
CR: 3

Topics may differ time to time, the course may be repeated for credit whenever the topics are different.

0410-525: GENERAL TOPOLOGY
CR: 3

Abstract topological spaces; connectedness, compactness, continuous functions. Metric spaces, complete metric spaces and metrizable spaces.

0410-526: ALGEBRAIC TOPOLOGY
CR: 3

Fundamental groups, surfaces, and homology theory.

0410-530: FOUNDATIONS OF GEOMETRY
CR: 3

Coordinatization, planar ternary rings and their algebraic properties, coordinatizing the dual plane, conditions for linearity, division rings with inverse properties, alternative division rings, the Artin-Zorn theorem, quasi fields and translation planes, division ring planes, some non-desarguesian planes.

0410-531: DIFFERENTIABLE MANIFOLDS
CR: 3

Manifolds, the topology of manifolds, differentiation on a manifold, vector fields, linear and affine connections, distributions, Riemannian manifolds.

0410-532: TOPICS IN DIFFERENTIAL EQUATIONS
CR: 3

Special topics not covered in other courses. May be repeated for credit under different subtitles.

0410-535: GRAPHS AND HYPER GRAPHS
CR: 3

The path problem, the flow problems,Vizing theorem, the Shannon theorem, chromatic number, chromatic polynomials, perfect graphs, hyper graphs.

0410-537: COMBINATORICS
CR: 3

Different ways of counting, double count, recurrence relations, generating functions, binomial theorem, Inclusion-exclusion principle, Stirling numbers, systems of distinct representatives, combinatorial structures including Latin Squares and designs.

0410-542: Scientific Computing Mathematical Models And Algorithms
CR: 3

Mathematical modeling using systems of differential equations to model real situations, large systems of linear equations, sparse matrices, pseudo-inverse matrices, multilevel methods, factorization. Ordinary differential equations, initial value problems, one step and multi-step methods for solution, stiff equations, boundary value problems, shooting, difference and vibrational methods. Us g Finite difference methods and multigrid techniques to solve partial differential equations.

0410-543: Advanced Numerical Computing
CR: 3

Fitting of Data: B-spline re.presentations, calculating with B- spUnes, knot insertion algorithms, curve fitting with splines; Surface Fitting: meshed data methods, scattered data methods; Transforms and Filtration of Data: Fourier transfonns, convolution and correlation, sampling theorem, deconvolution problem; Multi-level Projections:
reconstruction from pro jections discrete proiectiohs iterative image reconstruction.

0410-560: NUMERICAL SOLUTION OF ODE'S
CR: 3

Concepts of discretization (initial value problems, boundary value problems, integral equations). Difference methods and Galerkin methods. Consistency, stability and convergence. Linear multistep methods, stability theory, spline collocation methods, stiff equations. Two-point boundary value problems, difference methods, shooting techniques, finite elements.

0410-561: COMPUTATIONAL LINEAR ALGEBRA
CR: 3

Basic concepts, Gaussain Elimination and LU-decomposition, QR-Factorization and Lease Square problems, Eigenvalue problems and SVD, Iterative Methods.

0410-568: TOPICS IN NUMERICAL MATHEMATICS
CR: 3

Topics may differ time to time, the course may be repeated for credit provided the topics are different.

0410-593: PROJECT
CR: 3

The student undertakes an independent project on a research topic of theoretical and/or experimental focus under the supervision of a faculty member listed in the supervisory list of the College of Graduate Studies. The objective is to provide the student with an opportunity to integrate and apply the knowledge gained throughout the course of study in a practical problem. The student must document the project in a scientific report following standard research writing guidelines and give a public presentation to the project examination committee.

0410-597: THESIS
CR: 0

0410-598: THESIS
CR: 0

2000-599: THESIS
CR: 9