COLLEGE OF SCIENCE

May 26, 2013

ACADEMIC DEPARTMENTS

The College of Science has five Academic Departments as given hereafter.

Academic Department	***Degrees***
Mathematical Sciences	*Bachelor of Science Degree in Mathematics*
Physics	*Bachelor of Science Degree in Physics*
Chemistry	*Bachelor of Science Degree in Chemistry* *Bachelor of Science Degree in Biochemistry*
Biology	*Bachelor of Science Degree in Biology (General Biology Concentration)* *Bachelor of Science Degree in Biology (Environmental Biology Concentration)* *Bachelor of Science Degree in Biology (Cellular and Molecular Biology Concentration)*
Geology	*Bachelor of Science Degree in Geology (Applied Geology Concentration)* *Bachelor of Science Degree in Geology (Petroleum Geology Concentration)*

GRADUATION REQUIREMENTS

A student must obtain 120 ***Credit Hours*** *to graduate according to the following:*

1. Common Requirements 30 - 36 Credit Hours depending on the major chosen.

The following common requirements apply to all students in the College:

1.1 University General Requirements ***21 - 27 Credit Hours***

1.2 College Compulsory Requirements *9* ***Credit Hours***

Course No.	***Course Title***	***Semester***	***Prerequisite***	***Credit Hours***
ITBP 103	*Principles of Information Technology*	*1&2*	***INTU 1420***	*3*
MATH 105	*Calculus 1*	*1&2*	***MATU 1435***	*3*
PHYS 105	*General Physics 1*	*1&2*	***MATU 1435***	*3*

1.3 Free Elective Requirements ***0-3 Credit Hours***
The student may select any course offered by the any of the Colleges to fulfill this requirement

2. Major specialization and supporting courses requirement: 75 to 87 Credit Hours, *selected to fit the chosen major as set out in the specifications of each individual department.*

Department Of Mathematical Sciences

The Department offers the Degree of Bachelor of Science in Mathematics. It also offers a minor in Mathematics for students of other departments and colleges. Currently, 3 Professors, 5 Associate Professors, 14 assistant professors, 8 instructors and a number of teaching assistants are affiliated with the department.

Graduation Requirements

1. Common Requirements ***33 Credit Hours***

1.1 University general requirements *24* ***Credit Hours***

1.2 College compulsory requirements *9* ***Credit Hours***
(Details about the above common requirements are provided under the section entitled college of science)

2. Major Specialization and Supporting Courses Requirements ***87 Credit Hours***
(2.1) Major Compulsory Requirements: *33* ***Credit Hours***
(2.2) Major Elective Requirements: *9* ***Credit Hours***
(2.3) Supporting Compulsory Requirements: *12* ***Credit Hours***
(2.4) Supporting Elective Requirements: *33* ***Credit Hours****.*
Total: ***120 Credit Hours.***

Major Specialization Requirements ***42 Credit Hours***
A. Compulsory Courses ***33 Credit Hours***

Course No.	***Course Title***	***Semester***	***Prerequisite***	*CH*
MATH 110	*Calculus II*	*1&2*	*MATH 105*	*3*
MATH 140	*Linear Algebra I*	*1&2*		*3*
MATH 210	*Calculus III*	*1&2*	*MATH 110 + 140*	*3*
MATH 215	*Introduction to Analysis*	*1&2*	*MATH 110 + 140*	*3*
MATH 275	*Ordinary Differential Equations*	*1&2*	*MATH 110 + 140*	*3*
MATH 310	*Real Analysis*	*1&2*	*MATH 215*	*3*
MATH 315	*Complex Analysis I*	*1&2*	*MATH 210 + 215*	*3*
MATH 320	*Numerical Analysis I*	*1&2*	*MATH 210*	*3*
MATH 340	*Abstract Algebra*	*1&2*	*MATH 215*	*3*
MATH 470	*Mathematical Modeling*	*1&2*	*Accomplishment of 96 CH*	*3*
MATH 495	*Research Project*	*1&2*	*Accomplishment of 96 CH*	*3*

B. Elective Courses ***9 Credit hours***
Student has to select 9 Credit Hours from either one or both of the following two lists:
List A: Pure Mathematics List

Course No.	***Course Title***	***Semester***	***Prerequisite***	*CH*
MATH 246	*Number Theory*	*2*	*MATH 215*	*3*
MATH 260	*Foundations of Geometry*	*1&2*	*MATH 110 + 140*	*3*
MATH 341	*Linear Algebra II*	*1*	*MATH 215*	*3*
MATH 342	*Graph Theory*	*2*	*MATH 215*	*3*
MATH344	*Introduction to Cryptography and Coding Theory*	*2*	*MATH215*	*3*
MATH 413	*Complex Analysis II*	*1*	*MATH 315*	*3*
MATH 462	*Introduction to Topology*	*2*	*MATH 310*	*3*
MATH 491	*Selected Topics in Pure Mathematics*	*1*	*Departmental Consent*	*3*

List B: Applied Mathematics List

Course No.	***Course Title***	***Semester***	***Prerequisite***	*CH*
MATH 321	*Linear Programming*	*1*	*MATH 210*	*3*
MATH 372	*Partial Differential Equations*	*2*	*MATH 210 + 275*	*3*
MATH 374	*Dynamical Systems and Applications*	*2*	*MATH 210 + 275*	*3*
MATH 391	*Financial Mathematics*	*1*	*MATH 320 + STAT 230*	*3*
MATH 422	*Numerical Analysis II*	*2*	*MATH 320*	*3*
MATH 471	*Control Theory and Applications*	*1*	*MATH 275*	*3*
MATH 492	*Selected Topics in Applied Mathematics*	*2*	*Departmental Consent*	*3*

Supporting Requirements ***45 Credit hours***

A. Compulsory Courses: ***12 Credit hours***

Course No.	***Course Title***	***Semester***	***Prerequisite***	*CH*
ENG 310	***Rhetoric and composition 3 B***	*1&2*	*-*	*3*
PHYS 110	*General Physics II*	*1&2*	*PHYS 105*	*3*
PSY 313	*Educational Psychology*	***1***	*-*	*3*
STAT 230	*Principles of Probability*	*1&2*	*MATH 110*	*3*

B. Elective Courses: ***15 Credit hours***

Course No.	***Course Title***	***Semester***	***Prerequisite***	*CH*
*ARAB **100***	*Styles of Literary Expression*	*1 & 2*	*-*	*3*
*ARAB **110***	*Introduction to Syntax and Morphology*	*1 & 2*		*3*
*ENG **250***	***English Grammar & Usage***	*1 & 2*	*-*	*3*
ITBP119	***Algorithms & Problem Solving (new)***	*1 & 2*	*-*	*3*
ITBP 219	*Object-oriented Programming*	*1 & 2*	*ITBP 119*	*3*
MATH 500	*Internship*	*1 & 2*	*114 CH & GPA >2.0*	*6*
STAT 210	*Probability and Statistics*	*1 & 2*	*MATH 110*	*3*
STAT340	***Mathematical Statistics (new)***	*1 & 2*	*STAT210 + STAT230**	*3*

C. With department approval, a student may use a sequence of courses, 18 Credit hours, as an academic minor.

Other Minors may be considered with approval of both the department and the corresponding college.

The minor in Mathematics is available to students whose major is not Mathematics. Further information on this option is available at the end of this program description.

Minor In Mathematics

The department offers a minor in Mathematics for the students of other departments and colleges.

Course No.	***Course Title***	***Semester***	***Prerequisite***	***CH***
MATH 105	*Calculus I*	*1 & 2*	*MATU1435*	*3*
MATH 110	*Calculus II*	*1 & 2*	*MATH 105*	*3*
MATH 140	*Linear Algebra I*	*1 & 2*		*3*
MATH 210	*Calculus III*	*1 & 2*	*MATH 110 + 140*	*3*
MATH 215	*Introduction to Analysis*	*1 & 2*	*MATH 110 + 140*	*3*
MATH 246	*Number Theory*	*2*	*MATH 215*	*3*
MATH 260	*Foundation of Geometry*	*1 & 2*	*MATH 110 + 140*	*3*
MATH 275	*Ordinary Differential Equations*	*1 & 2*	*MATH 110 + 140*	*3*
MATH 310	*Real Analysis*	*1 & 2*	*MATH 215*	*3*
MATH 315	*Complex Analysis 1*	*1 & 2*	*MATH 210 + 215*	*3*
MATH 320	*Numerical Analysis 1*	*1 & 2*	*MATH 210*	*3*
MATH 321	*Linear Programming*	*1*	*MATH 210*	*3*
MATH 372	*Partial Differential Equations*	*2*	*MATH 210 + 275*	*3*
MATH 422	*Numerical Analysis 2*	*2*	*MATH 320*	*3*

Courses Descriptions

MATH 105: Calculus I ***3 Credit Hours (2+2)***

Limits and continuity of functions. The derivative, rate of change, the chain rule, and related rates. Derivatives of trigonometric functions. Extreme value theorem, the mean value theorem, applied max-min. problems and curve sketching. Antiderivatives, the definite integral, and the fundamental theorem of calculus. ***(Prerequisite: MATU1435)***

MATH 110: Calculus II ***3 Credit Hours (2+2)***

Applications of definite integrals: volume, arc length, and surface area. Inverse trigonometric and transcendental functions. Techniques of integration: Integration by parts, trigonometric substitution, the methods of partial fractions, etc. L'Hopital's rule and improper integrals. Polar coordinates. Vectors in space: the dot and cross products, lines and planes in space.
(Prerequisite: MATH 105)

MATH 140: Linear Algebra I ***3 Credit Hours (2+2)***

Systems of linear equations, matrices and determinants. Vector spaces, inner product spaces. Matrix representations of linear operators. Eigenvalues, eigenvectors, and Cayley-Hamilton Theorem. ***(Prerequisite: non)***

MATH 210: Calculus III ***3 Credit Hours (2+2)***

Infinite sequences, upper and lower limits. Infinite series, tests for convergence, absolute and conditional convergence. Vector valued functions. Curves and surfaces in space. Functions of several variables: graphs, limits, continuity, partial derivatives, the chain rule, the gradient, constrained extreme and Lagrange multipliers. Double and triple integrals, change of variables in multiple integrals. ***(Prerequisite: MATH 110 & MATH 140)***

MATH 215: Introduction to Analysis ***3 Credit Hours (3+0)***

Sets, functions, cardinality, countable and uncountable sets, methods of proofs, mathematical induction. Completeness of the line, supremum and infimum, Cantor's nested intervals theorem. Sequences, limits and their properties, monotone sequences, Bolzano-Weierstrass Theorem, Cauchy criterion, properly divergent sequences. Series, absolute and conditional convergence, tests of convergence. ***(Prerequisite: MATH 110 & MATH 140)***

MATH 246: Number Theory ***3 Credit Hours (3+0)***

Divisibility, Euclidean algorithm, prime numbers, the fundamental theorem of arithmetic, and the sieve of Eratosthenes. Congruences, Chinese Remainder theorem. Fermat's theorem, Wilson's theorem, Euler's theorem, and Diophantine equations. ***(Prerequisite: MATH 215)***

MATH 260: Foundations of Geometry ***3 Credit Hours (3+0)***

Euclid's postulates and plane geometry. Von-Neumann postulates. The parallel postulate. Affine geometry and geometry on the sphere. Projective and hyperbolic geometries. Klein-Beltrami and Poincare models of the plane. Pappus and Desargues theorems. Transformations: automorphisms, motions, similarities, and congruence. ***(Prerequisite: MATH 110 & MATH 140)***

MATH 275: Ordinary Differential Equations ***3 Credit Hours (3+0)***

First order differential equations: examples, separable equations, homogeneous and exact equations, integrating factor and Bernoulli's equation, linear equations, initial value problems. Higher order differential equations: linear equations, linear independence and Wronskian matrices, existence and uniqueness of solutions. Particular solutions: the method of undetermined coefficients, the method of variation of parameters. Laplace transforms and initial value problems. Series solution of differential equations. System of equations and their matrix form. ***(Prerequisite: MATH 110 & MATH 140)***

MATH 310: Real Analysis ***3 Credit Hours (3+0)***

Functions: Limits, theorems on limits; continuity, theorems on continuity, and nested interval theorem; uniform continuity, Extreme Value theorem, Bolzano-Weierstrass theorem, Heine-Borel theorem. Differentiation: Mean Value theorem and L'Hospital's rule. Riemann integral: lower and upper sums, theorems on integration, the fundamental theorem of calculus and its applications. ***(Prerequisite: MATH 215)***

MATH 315: Complex Analysis I ***3 Credit Hours (3+0)***

Complex numbers: properties and representations. Complex functions: limits, continuity, and the derivative. Analytic functions: Cauchy - Riemann equations, harmonic functions, elementary analytic functions. Integration in the complex plane: complex line integrals, Cauchy integral theorem, Morera's theorem, Cauchy integral formula; Maximum principle. Liouville's theorem and the fundamental theorem of algebra. ***(Prerequisite: MATH 210 & MATH 215)***

MATH 320: Numerical Analysis I ***3 Credit Hours (2+2)***

Error analysis: solutions of non-linear equations in one variable, bisection, fixed point, and false position methods, Newton and secant methods; Solution of a system of linear equations: Gaussian elimination method, Cholesky factorization method. Iterative

methods: Interpolation: Lagrange, divided differences, forward, backward, and central methods. Numerical differentiation, two, three and five point formulas. Numerical integration, trapezoidal, Simpson's rules and composite quadrature.
(Prerequisite: MATH 210)

MATH 321: Linear Programming ***3 Credit Hours (3+0)***
The general Linear Programming Problem. The Simplex method. The revised Simplex method. Computer implementations. Duality. Parametric linear programming. Interior point methods. Applications including: transportation problem, inventory problems, blending problems and game theory. ***(Prerequisite: MATH 210)***

MATH 340: Abstract Algebra ***3 Credit Hours (3+0)***
Groups: examples, subgroups, cyclic subgroups; cosets and Lagrange's theorem; Cyclic groups and permutation groups. Normal subgroups, quotient groups; homomorphisms and isomorphisms; Direct products of groups. Rings: examples, sub rings, ideals, quotient rings, integral domains, Fields. Ring homomorphisms and isomorphisms. ***(Prerequisite: MATH 215)***

MATH 341: Linear Algebra II ***3 Credit Hours (3+0)***
Linear Transformations: Isomorphisms of vector spaces, representation by matrices, and change of basis. Eigenvalues and eigenvectors: diagonalization and triangularization of linear operators. Inner product spaces: Orthogonalization and Rieze representation theorem. Self-adjoint operators: the Spectral theorem, Bilinear and quadratic forms. ***(Prerequisite: MATH 215)***

MATH 342: Graph Theory ***3 Credit Hours (3+0)***
Definition of a graph. Examples, paths and cycles: Eulerian and Hamiltonian graphs. Application to "shortest path" and "Chinese postman" problems, trees, applications, including "enumeration of molecules" planar graphs, graphs on other surfaces, dual graphs. Coloring maps edges, vertices. Digraphs, Markov chains, Hall's marriage theorem and applications. Network flows.
(Prerequisite: MATH 215)

MATH344: Introduction to Cryptography and Coding Theory ***3 Credit Hours (3+0)***
*This course introduces students to the principals and practices which are required for secure communication: cryptography and cryptanalysis, including authentication and digital signatures. Mathematical tools and algorithms are used to build and analyze secure cryptographic systems. Basic notions of coding theory will be also covered.****(Prerequisite: MATH215)***

MATH 372: Partial Differential Equations ***3 Credit Hours (3+0)***
Definitions and concepts: General and particular solutions. Elimination of arbitrary constants and functions. First order equations the method of characteristics. Second order equations: classifications hyperbolic, elliptic, parabolic, the normal form. Boundary value problems: the heat equation, the wave equation, Laplace equation, methods of solutions: separation of variables, the Fourier and Laplace transforms. ***(Prerequisite: MATH 210 & MATH 275)***

MATH 374: Dynamical Systems and Applications ***3 Credit Hours (3+0)***
One dimensional discrete dynamical systems. Steady states, stability, periodic points. Chaos. Lyapunov exponents. Symbolic dynamics. 2-dimensional systems. Mandelbort set. Fractals. Applications in ecology population growth, Predator-prey and competition models. Applications in medicine fractal structure of the lung, heart rat variability.
(Prerequisite: MATH 210 & MATH 275)

MATH 391: Financial Mathematics ***3 Credit Hours (3+0)***
Introduction to concepts of financial products and markets. Pricing of financial derivative securities. Options and markets, present and future values. Price movement modeled by Brownian motion, Ito's formula. Parabolic partial differential equations. Prices of European options as solutions of initial and boundary value problems for heat equations. American option and free boundary problems. Analytic solutions for European options. Numerical methods for options. Optional topics: Path dependent options, interest rate derivatives. ***(Prerequisite: MATH 320 & STAT 230)***

MATH 413: Complex Analysis II ***3 Credit Hours (3+0)***
Sequences and series of complex numbers, Power series, Taylor and Laurent expansions, differentiation and integration of power series, application of the Cauchy theorem: Residue theorem, evaluation of improper real integrals, conformal mappings, mapping by elementary functions. ***(Prerequisite: MATH 315)***

MATH 422: Numerical Analysis II ***3 Credit Hours (3+0)***
Approximation theory: Orthogonal and Chebyschev polynomials, rational and trigonometric polynomials, multiple integrals, initial value problems: Taylor's methods, multistep and Runge-Kutta methods, boundary value problems: shooting, finite difference and Rayleigh-Ritz methods. ***(Prerequisite: MATH 320)***

MATH 462: Introduction to Topology ***3 Credit Hours (3+0)***
Topological spaces, Bases and sub-bases, subspaces, finite product spaces, continuous maps, homomorphisms, Hausdorff spaces, metric spaces, compactness and connectedness, separation axioms. ***(Prerequisite: MATH 310)***

MATH 470: Mathematical Modeling ***3 Credit Hours (2+2)***

The modeling process, dimensional analysis, model fitting techniques, discrete models difference equations, logistic equation. Continuous models using derivatives for example: predator-prey, population, harvesting, models. Discussion of stability, phase plane. Applications using Mathematica.

(Prerequisite: Minimum of 2.0 GPA, completion of a minimum of 90 Credit hours, and departmental consent)

MATH 471: Control Theory and Applications ***3 Credit Hours (3+0)***

Introduction and motivation. Problem formulation. Systems models: linear and nonlinear systems. Optimal control problems arising from different fields. Calculus of variation with application to system modeling. Limitation of calculus of variation leading to modern control theory. Time optimal control, attainable state, reachable sets, and Bang-Bang principle. Pontryagin minimum principle and transversality conditions. Linear quadratic control problems. Optimal linear state feedback control. Applications: 3-axis attitude control of communication satellites, Road building and fisheries problems, Geo-synchronous satellites, Speed controls of electric motors. ***(Prerequisite: MATH 275)***

MATH 491: Selected Topics in Pure Mathematics ***3 Credit Hours (3+0)***

Selected topics in pure mathematics proposed by the instructor are offered upon the consent of the department.

(Prerequisite: departmental consent)

MATH 492: Selected Topics in Applied Mathematics ***3 Credit Hours (3+0)***

Selected topics in applied mathematics proposed by the instructor are offered upon the consent of the department.

(Prerequisite: departmental consent)

MATH 495: Research Project ***3 Credit Hours (3+0)***

Students are supervised during their formulation of research proposals. Instructors direct their students in carrying out different tasks leading to the execution of the projects. Students are required to give presentations regarding their achievements, and the written final reports are submitted for evaluation.

(Prerequisite: Minimum of 2.0 GPA, completion of a minimum of 90 Credit hours, and departmental consent)

MATH 500: Internship ***6 Credit Hours (6+0)***

The Internship training program is coordinated by both the department, academic supervisor and the faculty training committee. The program is continuously monitored and reviewed by a field supervisor staff member at one of the institutions, establishments, or work sites in the United Arab Emirates.

(Prerequisite: Minimum of 2.0 GPA, completion of a minimum of 114 Credit hours, and departmental consent)

Courses Offered To Other Colleges Or Departments:

MATH 1110: Calculus I for Engineers ***3 Credit Hours (2+2)***

Differential calculus of functions of one variable: functions of one variable. Techniques of differentiation. Derivatives of trigonometric, exponential, and logarithmic functions; chain rule; implicit differentiation. Maximum and minimum values. Increasing, decreasing and concave functions; inverse trigonometric functions; hyperbolic functions; some engineering applications. Integral calculus of functions of one variable: definite and indefinite integrals. Techniques of integration: integration by substitution; integration by trigonometric substitutions; integration by parts; integration by partial fractions. Applications of definite integrals in geometry. Some engineering applications. Functions of two variables. Students must attend an extra 1 hour of Math problem solving managed by CRU. ***(Prerequisite: MATU1435)***

MATH 1120: Calculus II for Engineers ***3 Credit Hours (2+2)***

Differential calculus of functions of several variables: Vector valued functions; functions of several variables; partial derivatives; chain rule; gradient and directional derivatives; extrema of functions of several variables. Quadratic surfaces. vector fields and line integrals; double integrals in Cartesian and polar coordinates; triple integrals in Cartesian, cylindrical and spherical coordinates. Students must attend an extra 1 hr of Math problem solving managed by CRU. ***(Prerequisite: MATH 1110)***

MATH 2210: Differential Equations and Engineering Applications ***3 Credit Hours (2+2)***

Ordinary differential equations: first order differential equations: separable; homogenous, linear, Bernoulli, exact-integrating factors. Second order linear differential equations: homogenous equations with constant coefficients; undetermined coefficients method; variation of parameters method; Euler's Equation; Non-homogenous equations; higher order linear equations; systems of differential equations. Laplace transforms: basic properties; solving initial value problems using Laplace; solving integral equations; solving systems of differential equations. Engineering applications. ***(Prerequisite: MATH 1120)***

MATH 2220: Linear Algebra and Engineering Applications ***3 Credit Hours (2+2)***

Linear algebra: matrices; determinants; system of linear equations; eigenvalues and eigenvectors; diagonalization. Some engineering applications. Complex analysis: complex numbers; complex variables; differentiation of complex functions; complex integration; conformal mappings. ***(Prerequisite: MATH 1120)***

MATH 245: Set Theory and Logic ***3 Credit Hours (3+0)***

Compound and simple propositions, truth table, quantifiers, propositional calculus, methods of proofs. Sets and operations on sets. Cartesian products, relations, equivalence relation, order relation. Functions, images of sets and cardinality.
(Prerequisite: MATH 110 & MATH 140)

MATH 305: Mathematics for Teachers I ***3 Credit Hours (3+0)***

Introduction to mathematical logic, sets, operation on sets, the set of natural numbers, the set of integers, the set of rational numbers, graphical representation of numbers, decimal representation of numbers, other bases, divisibility, solution of arithmetic problems, applications. ***(Prerequisite: MATU 1301 or MATU 1312)***

MATH 335: Mathematics for Teachers II ***3 Credit Hours (3+0)***

Geometrical figures in plane and space and their properties. Areas and volumes of geometrical figures; unitary and non-unitary linear transformations and their properties. Ratio, proportion, percentage and their practical applications. The geometric problem: construction and solutions methods. ***(Prerequisite: MATH 305)***