

## Description of courses and the specific objectives of each:

### 1. Real Analysis (I) (Math5311): تحليل حقيقي 1

This course concerns with Lebesgue measure: outer measure, measurable sets and functions, Egoroff's theorem, Lusin's theorem, convergence in measure, the Lebesgue integral: the integral of a bounded function over a set of finite measure, the integral of a nonnegative function, the general Lebesgue integral, Riemann and Lebesgue integrals, differentiation: differentiation of monotone functions, functions of bounded variation, differentiation of an integral.

### 1. Real Analysis (II) (Math ):2 تحليل حقيقي

This course concerns with introduction to general Measure and Integration, Measure spaces, Measurable functions. Integration, Signed measures. The Radon Nikodum Theorem. , absolute continuity, the Holder and Minkowski inequalities,  $L_p$  spaces: completeness of  $L_p$  classes, the duals of  $L_p$  classes, Banach spaces: linear operators, the Hahn-Banach theorem and other basic results, Hilbert spaces. The extension theorem. The Lebesgue-Stieltjes integral. Product measures .Topological vector spaces.

### 2. Functional Analysis (Math5331): تحليل دالي

This course concerns with hilbert spaces: the geometry of Hilbert space, the Riesz representation theorem, orthonormal bases, isomorphic Hilbert spaces, operators on Hilbert space: basic properties and examples, adjoints, projections, invariant and reducing subspaces, positive operators and the polar decomposition, self-adjoint operators, normal operators, isometric and unitary operators, the spectrum and the numerical range of an operator, operator inequalities, compact operators, Banach spaces: basic properties and examples, convex sets, subspaces and quotient spaces, linear functionals and the dual spaces, the Hahn-Banach theorem, the uniform boundedness principle, the open mapping theorem, and the closed graph theorem.

### 3. Complex Analysis (Math5330): تحليل مركب

This course concerns with analytic functions: power series, Laurent series, analytic functions as mappings, Mobius transformations, linear fractional transformations, conformal mappings, cross ratio, complex integration: zeros of analytic functions, Cauchy's theorem and formula, the argument principle, the open mapping theorem, the maximum modulus principle, Schwartz lemma, singularities: classification of singularities, residues, residue theorem, evaluation of real definite and improper integrals, normal families: Riemann mapping theorem, Schwartz reflection principle, Schwartz-Christoffel formulas, harmonic functions: Dirichlet problem, Poisson's formula, mean value property.

#### **4. Toplogy (Math5320): تولوجي**

This course concerns with topological spaces, neighborhoods, bases and subbases, continuous functions, product spaces, weak topologies, quotient spaces, filters, separation axioms, regular and completely regular spaces, normal and perfectly normal spaces, Lindelof, separable spaces and second countable spaces, compact spaces, locally compact spaces, sequentially and countably compact spaces, one point compactification, paracompact spaces, connected spaces. Locally compact and k-spaces, metric and metrizable spaces, complete metric spaces and the completion theorem, Baire spaces and Baire category theorem.

#### **5. Differential Equations (Math5312): معادلات تفاضلية**

This course concerns with basic definitions – some models of partial differential equations – classifications of P.D.E – separation of variables method – series method – laplace transform method– Fourier transform method – perturbation method.

#### **6. Fluid Dynamics (Math5344): ديناميكا الموائع**

This course concerns with introduction to tensor analysis – basic definitions- Newtonian fluids – Equation of continuity – Nerviier – Stokes equations. The motion between two plates – The motion through cylinder – Non Newtonian fluids – Equations of motion for non-Newtonian fluids – Applications Basic definitions – some models of partial differential equations – classifications of P.D.E – separation of variables method – series method – lap lace transform method – Fourier transform method – perturbation method.

#### **7. Analytical Dynamics (Math5345): ديناميكا تحليلية**

This course concerns with survey of the elementary principles- Variational principles and lagrange's equations- The Rigid Body Equations of motion- The Hamilton Equations of motion- Canonical Transformations- Hamilton – Jacobin theory- Constrained lograngians as fidd systems.

#### **8. Abstract Algebra (I) (Math5310):1 جبر حديث**

This course concerns with Groups, definitions and examples , groups of permutations , direct product, homomorphism and isomorphism, fundamental theorem of finite abelian groups, simple groups, Sylow theorems, introduction to free groups. Ring Theory, integral domains, ideals and factor rings, prime ideals, maximal ideals, ring

homomorphism, polynomial rings, factorization, divisibility in integral domains, fields, extension fields, algebraic extensions, finite fields .

### **9. Abstract Algebra (II) (Math5341):2 جبر حديث**

This course concerns with general noncommutative ring theory, chain conditions, sum and direct sum of rings, Wedderburn theorem, modules, module decomposition, modules over finite rings.

### **10. Advanced Number Theory (Math5334): نظرية العدد المتقدم**

This course concerns with Divisibility, primes, congruence, primitive roots and quadratic reciprocity, quadratic residues, Arithmetic functions, introduction to algebraic number theory, quadratic number fields, cyclotomic fields.

### **11. Coding Theory (Math5332): نظرية الترميز**

This course concerns with basic concepts for linear codes : linear codes, generators and parity check matrix, dual codes, weights and distances, Hamming codes, bounds on the size of codes, cyclic codes, zeros of a cyclic codes, minimum distance of cyclic codes, self dual codes, codes over  $Z_4$

### **12. Cryptography (Math5342): التشفير**

This course concerns with Mathematical Basics: Divisibility, Primes, An Introduction to Congruences , Euler, Fermat ,Complexity. Cryptographic Basics: Definitions and Illustrations ,Classic Ciphers , Stream Ciphers , LFSRs, Modes of Operation , Attacks, DES and AES, Public-Key Cryptography: RSA , ElGamal, DSA — The DSS. Factoring: Classical Factorization Methods ,The Continued Fraction, Algorithm, Pollard's Algorithms ,The Quadratic Sieve, The Elliptic Curve Method (ECM).

### **13. Statistics (Math5313): احصاء**

This course concerns with Counting, conditional probability and independence, random variables, distribution functions, density and mass functions. distributions of functions of a random variable, expected values, moments and moment generating functions. Discrete distributions. Continuous distributions, exponential families, location and scale Families, inequalities and identities. Joint and marginal distributions, conditional distributions and independence, bivariate transformations. Hierarchical models and mixture distributions, covariance and correlation,

multivariate distributions. Sums of random variables from a random sample, sampling from the normal distribution, properties of the sample mean and variance. Student's t and Snedecor's F. Order Statistics.

#### **14. Advanced Statistics (Math5340): احصاء متقدم**

This course concerns with Principles of Data Reduction: the sufficiency principle, the likelihood principle, the likelihood function. Methods of finding estimators; method of moments, maximum likelihood estimators, bayes estimators. Methods of evaluating estimators. Best unbiased estimators, sufficiency and unbiasedness. Hypothesis testing: likelihood ratio tests, Bayesian tests, union-intersection and intersection-union Tests, error probabilities and the power function, most powerful tests. Methods of evaluating interval Estimators. Point Estimation; consistency, efficiency. The mean and the median. Approximate maximum likelihood intervals. Analysis of variance. Linear regression. Models and distribution assumptions, estimation and testing with normal errors.

#### **15. Numerical Analysis (Math5321): تحليل عددي**

Approximation of functions, Numerical Integration and Differentiation, Numerical Solution of Ordinary and Partial Differential Equations, Approximation of Eigenvalues of Matrices.

#### **16. Special Functions (Math5333): دوال خاصة**

Series and integral representations, generating functions, recurrence relations and orthogonality properties of the special functions. Emphasis on Bessel, Legendre and hypergeometric functions.

#### **17. Advanced Geometry (Math5343): هندسة متقدمة**

This course will cover various advanced topics in Differential Geometry. Topics will be selected from the following: Asymptotic expansions of metric, volume, etc., Curvature decomposition and representation theory, Complex manifolds and Kaehler metrics, Hodge Theory and Fredholm Theory on compact Riemannian manifolds, Analysis on noncompact Riemannian manifolds.

#### **18. Special Topics (Math5350): مواضيع مختارة**

Special Topics allow a student the opportunity to personalize his or her education by engaging an experience in a particular area of Mathematics.

### **23. Seminar description السمنار**

Students are required to present seminars publically in topics of current interest, topics from the core courses, presentation of specific chemical research from recent literature or performed experimentation to members of the Mathematics faculty in 20-minute followed by 15-minute question and answer session . Students will be provided with the required skills in developing an overall understanding of the principles of oral communication in science including accepted presentation techniques, listening skills, critical analysis of scientific presentations, participation in scientific discussions in addition to critically reading the scientific literature.