المحتوى العلمى للمقررات الدراسية

Courses Contents

Faculty of Science

COURSE CONTENTS
(Credit-Hours System)

Mathematics Department

First Level

Math111 Differentiation and integration (1): (2h lecture and 2h tutorial /Weekly)

Descriptions: A. Inequalities and Absolute Values- Functions and Their Graphs- Types of Functions New Functions from Old Functions- Exponential Functions**-** Inverse Functions and Logarithms. B. Limits and Their Properties, Limits at Infinity, Horizontal Asymptotes- Indeterminate Forms and L'Hospital's Rule. C. Differentiation. D. Applications of Differentiation: Rates of Change in the Natural and Social Sciences- Exponential Growth and Decay- Related Rates- Linear Approximations and Differentials- Maximum and Minimum Values. E. Integration: Antiderivatives, The Definite Integral, Indefinite Integrals and the Net Change Theorem. F. Applications of Integration.

Math112 Algebra and Geometry: (2h lecture and 2h tutorial /Weekly)

Descriptions: Algebra: Mathematical induction and Partial fractions. Binomial theorem and its applications, Solution of cubic equations, Solution of 4th degree equations, Sets, subsets, set operations and inductively definition of sets, equivalence relations, equivalence classes, partitions and partial order, maps, composition of maps, kinds of maps and inverse functions. Geometry: 1- coordinate plane: Rectangular coordinates and polar coordinate – distance – change of axes - Straight line in plane and the common equation of two lines - Circle - The conic section: Parabola – Ellipse –Hyperbola - The general equation of the second degree in two variables.

Math113 Differentiation and integration (2): (2h lecture and 2h tutorial /Weekly)

Descriptions: Hyperbolic Functions. Applications of Differentiation: The Mean Value Theorem- How Derivatives Affect the Shape of a Graph- Graphing with Calculus *and* Calculators- Optimization Problems- Newton's Method. INTEGRALS: Areas between Curves- Volumes**,** Work. Integration Techniques**.** Approximate Integration, Improper Integrals. Applications of Integration: Arc Length, Area of a Surface of Revolution. Further Applications in Physics, Engineering, Economics and Biology.

Math 121 Mechanics (1): (2h lecture and 2h tutorial /Weekly)

Descriptions:Vector Algebra: Operations on vectors, Plane, Straight line. Reduction of forces, Equivalent sets of forces. Smooth hinges, Equilibrium of Frames- Motion of particles in a straight line, Motion in a resisting medium, Vertical motion under the earth's attraction.- Simple harmonic motion, Hook's law, Applications.

Math 122 Mechanics (2): (2h lecture and 2h tutorial /Weekly)

Descriptions:- Shear forces and bending moments in beams.- Linear integral, Work and energy, Virtual work principle, Stability of equilibrium positions.- Motion of bodies of variable mass, Rockets.- Motion in plane, Projectiles.- Motion of a particle on a circle.- Impulse, Impulsive forces and impact of elastic bodies.

Uni 102 Introduction to Computer Science: (2h lecture and 1h tutorial /Weekly)

Descriptions: Computer hardware: input and output devices, memory, CPU, ALU, control unit, and Expansion Cards. Computer networks: Model and protocol, LAN, MAN, and WAN nets. Data representation: Data types, text, numbers, images, audio, and video. Hexadecimal and octal notation and their conversion. Number representation: binary and decimal system and their conversion. Integer representation, Unsigned, sign-and-magnitude, one's complement, two complement methods. Floating point representation, normalization, sign, exponent and mantissa, IEEE standards. Operations on Bits: arithmetic and logical operations, truth table, unary operator, binary operator, applications. Algorithms: concept, construct (sequence, decision, and repetition), flowchart, pseudocode, subalgorithms, basic algorithms (summation, product, smallest, largest, sorting, and searching.

Second Level

Math 207 Mathematical Biology :(2h lecture and 1h tutorial /Weekly)

Descriptions: Linear Difference Equations and its applications to population Growth. - Nonlinear Difference Equations; Steady states and fixed points. Stability. Period doubling bifurcations. Chaos. Applications of Nonlinear Difference Equations to Population Biology; Host-parasitiod systems - Continuous Processes and Ordinary Differential Equations; An Introduction to Continuous Models; Phase-Plane Methods and Qualitative Solutions; Structural stability and instability. Lyapunov functions. Applications of Continuous Models to Population Dynamics, Prey-predator models. Limit Cycles, Oscillations, and Excitable Systems.Epidemic models.

Math 210 Ordinary Differential Equations :(2 h lectures and 2 h tutorials /Weekly)

Descriptions: Definitions. First-order differential equations: linear, separable, exact and homogenous, Second-order differential equations, reduction of order, constant coefficients; Second-order linear equations: ordinary points and regular singular points. Euler's equation. Introduction to systems of first-order equations. Solutions of two linear first-order equations. Introduction to Partial differential equations – order – homogenous and non homogenous – degree-linear and nonlinear- Heat equation, Wave equation and Laplace's equation in both one and higher dimensions. Separation of Variables and solutions of boundary value problems.

Math 211 Real Analysis: (2h lecture and 2h tutorial /Weekly)

Descriptions: 1- Numbers: Real numbers: Inequalities, Least upper bounds and greatest lower bounds. 2- Sequences of real numbers: Introducing sequences, Null sequences, Convergent sequences, Divergent sequences, The Monotone Convergence Theorem. 3- Series of real numbers: Introducing series, Series with non-negative terms, Alternating series, Stirling's Formula for n!. 4- Power series: Taylor polynomials, Taylor’s Theorem, Convergence of power series, Manipulating power series. 5- Fourier expansions.

Math 212 Abstract Algebra (1) :(2h lecture and 2h tutorial /Weekly)

Descriptions: Maps, kinds of maps, operations, groupoids and all essential kinds of groupoids Groups, subgroups and its properties Cyclic groups. Symmetric groups and permutation groups. Normal subgroups and factor groups. Homomorphism theorems of groups and Automorphisms group. P-Groups and Sylow Theorems. Rings and fields.

Math 213 Pure Mathematics :(2h lecture and 1h tutorial /Weekly)

Descriptions: Functions of more than one variable - Continuity – Partial differentiation and it's applications (Implicit function, Taylor expansion, differentiation under the sign of integration, Maximum and minimum values) – Multiple integrals – Linear integrals - Conditional maxima and minima (Lagrange Multiplier). Differential Equations: Separable – Homogeneous – Equations

tends to homogenous and separable – Exact – Integrating factor – Bernoulli's equations – Applications – Linear differential equation with order two and three.

Math 214 Ordinary Differential Equations (1) :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 113

Descriptions: Descriptions: Determining and classification of Differential Equations. First-order differential equations: linear, separable, exact, homogenous, Bernoulli Equation and Picard's Method. Applications of first-order Differential Equations. Higher-order Linear equations: Reduction of order, Undetermined Coefficients, Variation of Variables, The Differential Operator D, Cauchy- Euler equation.

Math 215 Linear Algebra (1) :(2h lecture and 2h tutorial /Weekly)

Descriptions: What is a field and examples of the well-known fields. Matrices defined over a field, operations on matrices, Echelon form. Algebra of square matrices, inverted matrix and system of linear equations. What is a vector space, subspaces, intersection and addition of subspaces. Linear combination, dependently and independently set of vectors, Basis and Dimension of a vector space. Linear transformations and linear operators and its proprties. Transformation from basis to another basis. Eigenvalues and eigenvectors. Similar matrices and diagonalization for square matrices. Applications.

Math 216 Calculus of Several Variables :(2 h lectures and 2 h tutorial /Weekly)
Pre-requisite: Math 113

Descriptions: Descriptions: This course develops further the basic topics of differentiation and integration of functions of several variables. The course consists of two main parts: Part 1 : Differential calculus of functions of several variables - Limits and continuity - Partial derivatives - Directional derivatives and the gradient -Normal lines and tangent planes – Extreme values - Lagrange multipliers - applications. Part 2: Multiple Integrals- Double integrals in different spaces and some applications - Triple integrals in different spaces with some applications - Transformation of coordinates - Change of variables in multiple Integrals.

Math 217: Introduction to Logic :(2h lecture and 1h tutorial /Weekly)

Descriptions: The Propositional Logic 1 - Propositional Calculus and proofs - Predicate Logic and Quantifiers - Divisibility Theory of Integers - The Theory of Congruences - Primes and Their Distributions - Finite Continued Fractions.

Math 218 Solid Analytic Geometry :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 112

Descriptions: Cartesian and parametric equation for plane in space.
Cartesian and parametric equations for Line in space. Cartesian and parametric sphere equations for sphere. Cartesian and parametric circles equations for circles in space. Relations between Lines, planes and spheres in space. Paraboloid and ellipsoid, surface in space. Tangent plane of surfaces in space. The general equation of the 2^{nd} degree in 3 variables. General theory of quadratic surfaces.

Math 219 Discrete Mathematics :(2h lecture and 1h tutorial /Weekly)

Descriptions: Proof. Deduction. Contradiction. Mathematical Induction. Factor. Division. Greatest common divisor. Least common multiple. Euclid algorithm. Infinity of primes. Irrationality of 2^5. Existence and uniqueness of prime factors. Modular arithmatic. Congruence. Euler function. Fermat-Euler theorem. Elements of cryptography.

Math 221 Mechanics (3): (2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 121

Descriptions: 1- Vector Analysis. 2- Moments of inertia 3- Equilibrium of Beams and chains. 4- Bending and shear forces. 5- Hydrostatics. 6- Electro-statics (Attraction and Potential)

Math 223 Mechanics (4) :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 122

Descriptions: Plane motion of a particle. Kinematics. Intrinsic coordinates. Constrained motion. Stability of equilibrium and stationary motion – Damped simple harmonic motion – forced vibrations. Central orbits. Elements of celestial Mechanics. Orbital motion of planets and Satellites. Motion of a particle in three dimensions. Motion on a smooth surface. Motion on a rotating earth. Plane motion of a rigid body.

Math 231 Introduction to Statistics and Probability :(2h lecture and 2h tutorial /Weekly)

Descriptions: Introduction (Descriptive statistics, Inferential statistics, Population, Sample, parameter, Statistic, Variable). Types of data (Qualitative and Quantitative Data). Frequency tables (simple frequency table, Grouped frequency table). Graphical representation of the data. Measures of central tendency, Measures of dispersion. Correlation for quantitative and qualitative data (Pearson, Spearman, contingency, compatibility and Kindle correlation coefficients). Count techniques (ordered and nonordered samples). Introduction to probability theory: Random experiment, Sample space, Event, Operations on events, Probability of an Event, Some Probability Laws, Conditional Probability, Independence, Total probability, Bayes Rule.

Math 232 Probability Theory (1):(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Introduction (algebra, sigma-algebra, probability measure, probability space). Random variables (Definition of the random variable as a measurable real valued function). Types of random variables (discrete and continuous). Probability distribution, Probability mass function, density function, Mean, Variance, expected value of a function of random variable, properties of the mean and the variance. Commutative distribution function (Definition, properties). Chebyshev and Jensen inequalities. Moments, skewnes, kurtosis and moment generating function. Discrete probability distributions: Bernoulli, Binomial, Poisson, Discrete uniform, Geometric and Negative Binomial. Continuous Distributions: Uniform, Normal, Exponential, Gamma, Beta and Weibull distribution.

Math 241 Computer Architecture and Assembly Language:(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 102
Description: Register transfer language, bus and memory transfer, arithmetic, logic and shift micro-operations. Basic computer organization and design: instruction codes, computer registers and common bus systems, computer instruction set, timing and control, instruction cycle, memory reference instructions, input-output and interrupt instructions, complete computer description, and design of basic computer. Hardwired and micro-programmed control: hardwired control methods, hardwired control examples, control memory, address sequencing, micro-program example, and design of control unit. Central processing unit: general register organization, stack organization, single-accumulator organization, instruction formats, addressing modes, data transfer and manipulation, program control, CISC and RISC computers, and examples of CISC and RISC processor. Computer arithmetic: addition, subtraction, multiplication and division algorithms, and floating point arithmetic operations. Input-output organization: input-output interface, asynchronous data transfer, priority interrupt, DMA, IOP, and serial communication. Memory organization: memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory.

Math 242 Computer Algebra :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 102

Descriptions: 1- Introduction to symbolic mathematics systems in general and Maple in particular. 2- Effective use of Maple. 3- Numbers and Functions. 4- Manipulating Algebraic

Expressions. 5- Solutions of Equations. 6- Programming in Maple. 7- Graphics. 8- Other applications based on student interests.

Math 243 Computer Networs:(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 102

Descriptions: Standards bodies. Switched vs. packets networking. OSI model. Internet model (TCP/IP). Nodes & links. LAN, WAN. Bandwidth, throughput. Components and architectures. Routing and switching. Communication protocols. Application, Transport, and network layers protocols.

Third Level

Math 301 Numerical Analysis :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Uni. 102

Descriptions: 1) Introduction, Computer Arithmetic and Errors. 2) Calculus of Finite Differences. 3) Difference Equations. 4) Linear Systems of Equations. 5) Interpolation. 6) Applications - Computer Subroutine Packages. Including MAPLE and MATLAB).

Math 310 Linear Algebra (2) :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 215

Descriptions: Inner product vector spaces. Symmetric, Hermitian, Unittary and Orthogonal matrices. Eigenvalues and Eigenvectors, Diagonlization of Matrices, Characteristic and minimum polynomials. Triangular Form, LU factorization, Invariant subspaces and primary decomposition. Nilpotent Operators and Jordan Canonical form, Rational Canonical form. Applications.

Math 311 Measure Theory :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 112

Descriptions: 1) Basic definitions. 2) Riemann integration. 3) Measure function, Lesbegue measure. 4) Measurable functions. 5) Lesbegue integration. 6) Measure dynamics.

Math 312 Complex Analysis (1) :(2h lecture and 2h practical /Weekly)
Pre-requisite: Math 113

Descriptions: 1) The complex number system. 2) Functions of complex variable. 3) Complex differentiation and the Cauchy – Riemann Equation. 4) Harmonic functions. 5) Complex integration and Cauchy integral Theorem. 6) Cauchy's integral formulas and related Theorems. 7) Taylor and Laurent's series. 8) Residues and poles Evaluation of integrals.

Math 313 Numerical Analysis (1) :(2h lecture and 2h practical /Weekly)
Pre-requisite: Math 214

Descriptions: (1) Introduction: Representation of numbers in computers ,Sources of errors, Exact and approximate numbers, Absolute, Relative and Percentage errors. (2) Calculus of finite differences and didderence equations: Finite difference operators , Factorial notation, Forward difference table, Fundamental theorem of difference calculus, Representation of a polynomial using factorial notation, Summation of series, Slution of dfference equations.
(3) Solving linear systems of equations: Elementary row operations , Gauss elimination method , Gauss-Jordan method, LU factorization (decomposition) method, Solving some special linear systems, Solution of linear system of equations using Jacobi, Gauss-Seidel and SOR Iterative methods, Ill-conditioned linear systems. (4) Interpolation: Lagrange interpolating polynomial, Divided differences, Newton interpolating polynomial, Inverse interpolation, Hermite interpolating polynomial. (5) Numerical differentiation DIFF: Computing first and second derivatives numerically. (6) Numerical integration: Newton-Cotes formulae, Trapezoidal rule, Composite trapezoidal rule, Simpson’s rule, Romberg integration, Gaussian quadrature.

Math 314 Probability Theory (1) :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Introduction (random experiment and sample space). Random variables and Types of random variables (discrete and continuous). Probability distribution, Probability mass function, density function, mean, variance, expected value of a function of random variable, properties of the mean and the variance. Commutative distribution function (Definition and properties). Moments, skewnes, kurtosis and moment generating function. Discrete probability distributions: Bernoulli, Binomial, Poisson, Discrete uniform and Geometric. Continuous Distributions: Uniform, Normal and Exponential distribution. Bivariate probability distributions, Marginal and conditional probability distributions, Independence correlation and covariance.

Math 315 Abstract Algebra 2 :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 212

Descriptions: What is a ring ○. ○All essential kinds of rings. Integral Domain and its properties. Unites, primes and irreducible elements. Subrings, ideals, prime and maximal ideals. Factor rings and homomorphism theorems. Fields, subfields and prime subfields, Extention of an integral domain to a field.

Math 316 Topology (1) :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 211

Descriptions: 1- Topological Spaces(Open sets – Neighborhoods- Closed sets – Closure of sets- Interior of sets – Exterior and boundary of sets – limit points – Dense and nowhere dense sets – Comparison of topologies – Subspaces.) 2- Bases and Subbases(Base for a topology – Subbase – topologies generated by classes of sets – Local bases.) 3-Continuity(Continuous functions – Continuity at a point – Open and closed functions – Homomorphisms – topological properties – Topologies induced by functions.) 4-Separation Axioms(T_0 – spaces, T_1 - spaces, T_2 - space, Regular and normal spaces, T_3 – spaces, T_4 – spaces) 5-Metric spaces(Metrics – Topology for a metric space – Distance between sets – Diameter of a set – Properties of metric topologies – Equivalent metrics.)

Math 317 Special Functions :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 211

Descriptions: 1- Gamma and Beta functions. 2-Hypergeometric functions. 3-Series solutions of differential equations. 4-Bessel functions and confluent hypergeometric functions. 5-Asymptotic expansions and Watson's lemma. 6-Orthogonal polynomials and some of its types such as Hermite, Laguerre, Jacobi, Legendre and Chebyshev polynomials. 7-Elliptic integrals and elliptic functions.

Math 318 Integral Equations :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 214

Descriptions: 1-Volterra Integral equations: (Relationship between linear differential equations and Volterra integral equation- Resolvent Kernel - Method of successive approximations - Convolution type and solution by Laplaces' transformation - Volterra integral equation of the first kind - Apel's integral equation and Euler integral) 2- Fredholm Integral Equations:(The method of Fredholm's determinant- Iterated Kernels- Degenerate Kernels- Homogeneous integral equations - Nonhomogenous symmetric equations)

Math 319 Number Theory :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 212

Descriptions: Divisibility. Congruence. Quadratic Reciprocity and Quadratic forms. Some Diophantine equations. Continued Fractions. Some Number- Theoretic Functions. Primes and Multiplicative Number Theory. Algebraic Numbers.

Math 321 Electrodynamics :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 223

Descriptions: Electrostatics, Magnetostatics, Electrodynamics, Basics of special relativity, Lorentz transformations, Relativistic kinematics and dynamics, 4-d geometry, The Electrostatic Scalar Potential, The Magnetostatic Vector Potential, The Electrodynamic Potentials- Covariant Classical Electrodynamics The Wave Equations, Plane Waves.

Math 322 Theory of Elasticity-1 :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 223

Descriptions: Stress theory. Strain theory. The relation between stresses and strains – Hook's law. Basic equations of elasticity theory and fundamental problems. Semi – inverse method and applications. Plane stress and strain problems. Torsion in beams.

Math 326 Analytical Mechanics :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 223

Descriptions: Types of mechanical systems . The general equation of dynamics. Lagrange's equations for holonomic systems. Lagrangian systems. Hamiltonian equation of motion. Hamiltonian systems. Equivalence and applicability of Lagrange's and Hamilton's equations. Integrals of motion . Cyclic variables. Natural and generalized natural systems. The energy. integral. Jacob's integral. The Hamiltonian integral. Routh's equations of motion. Variational calculus : Euler- Lagrange equations. Application. Hamilton's principle. Methods and model problems :Integrability of Hamiltonian systems. Jacobi's last multiplier , Liouville Integrability. Liouville systems separation of variables. curvilinear coordinates in the plane. Examples (Problem of two fixed centers, Stark problem,…). Rigid body dynamics : Description of rotation: Euler's angles . Angular velocity. Energy and angular momentum of a body. Inertia tensor and its properties. Euler- poisson equations of motion of a body about a fixed point. Integrals of motion. Integrable classes of motion of heavy rigid body.

Math 328 Statistical Mechanics :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 326

Descriptions: 1- Thermodynamics: Properties of Thermodynamic Systems, The Laws of Thermodynamic, Energy and Heat Capacity, Entropy, Thermodynamic Potentials. 2- Statistical Mechanics: Scope and Application of statistical mechanics, Phase Space, Statistical Ensemble, Distribution Laws, The Kinetic Theory of Gases, Maxwell-Boltzmann Distribution, The Maximum Distribution, The Most-Probable Distribution in-Energies, The partition Function. 3- , Quantum Statistics: Principle of In distinguishability, Degeneracy, Statistical Definition of Entropy. 4- Applications.

Math 330 Biostatistics :(2h lecture and 2h tutorial /Weekly)

Descriptions: Introduction; What is Biostatistics?, Observations and Variables, Scales Used with Variables, Randomized Response Technique. Descriptive Methods:- Introduction to descriptive methods, tabular and graphical presentation of data, frequency tables, frequency graphs, Measures of Central Tendency, Measures of Variability, Measures of Change over Time (Linear Growth, Geometric Growth, Exponential Growth), Correlation Coefficients (Pearson Correlation Coefficient, Spearman Rank Correlation Coefficient). Probability and Life Tables:- A Definition of Probability, Rules for Calculating Probabilities, Conditional Probabilities, Definitions from Epidemiology, Probability in Sampling (Sampling with Replacement, Sampling without Replacement), Some Uses of the Life Table, Expected Values in the Life Table. Probability Distributions:- The Binomial Distribution, The Poisson Distribution, The Normal Distribution, The Central Limit Theorem and Approximations to the Binomial and Poisson Distributions. Study

Designs:- Sampling and Sample Designs, Designed Experiments and Variations in Study Designs. Interval Estimation:- Confidence Intervals Based on the Normal Distribution, Confidence Interval for the Difference of Two Means and Proportions, Confidence Interval and Sample Size and Prediction and Tolerance Intervals Based on the Normal Distribution. Tests of Hypotheses:- Preliminaries in Tests of Hypotheses, Testing Hypotheses about the Mean, Testing Hypotheses about the Proportion and Rates, Testing Hypotheses about the Variance.

Math 331 Probability Theory (2) :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Introduction (Definition of bivariate random variables). Bivariate Distributions (joint distribution of two discrete/continuous random variables, marginal distribution, conditional distribution, product/conditional expectation of two random variables, variance/covariance of two random variables, correlation and independence of two random variables. Bivariate normal distribution. Joint moment generating function. Distribution of functions of random variables (Functions of one random variables, Transformations of two random variables, several independent random variables, and the moment generating function technique, random functions associated with normal distributions, the central limit theorem and approximations for discrete distributions).

Math 332 Estimation Theory :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 232

Descriptions: Introduction. Methods of finding the point estimators (moment estimators, Maximum Likelihood estimators and other methods). Properties of the point estimators (Closeness, Mean-squared error, unbiasedness, consistency, sufficiency, minimal sufficiency). Exponential family. Uniformly Minimum Variance Unbiased Estimator, Cramer-Rao inequality, Fisher's information, Rao-Blackwell theorem, Sufficiency and Completeness, Lehmann-Sheaffe theorem. The loos function approach. Location invariant and scale invariant. The Bayesian Approach (Use of a prior density, Bayes estimators, Bayes estimators with mean square error loss function). Sampling distribution for the one sample statistic (mean, variance and proportion). Interval estimation for one population parameter.

Math 333 Statistical Theory :(2h lecture and 2h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Sampling distributions:- The sampling distribution of the mean, variance and the proportion, the sampling distribution of the difference between means and between the proportions, the sampling distribution of the ratio of variances. Parametric point estimation:- Properties of the estimators, the Information function, the methods of the point estimations. Parametric interval estimation:- The confidence interval of the unknown parameter of one population, the confidence interval of the difference between two unknown means, the confidence interval of the difference between two proportion, the confidence interval of the ratio of the variances of two populations. Tests of hypotheses for a single sample:- About the mean, proportion and the variance of the population.

Math 334 Sampling Techniques :(2 h lectures and 2 h tutorials /Weekly)
Pre-requisite: Math 231

Descriptions: Introduction:- Definition of population and sample, Requirements of a Good Sample, Measurement Error, Questionnaire Design, Sampling and Non-Sampling Errors. Simple Probability Samples:- Types of Probability Samples, Simple Random Sampling, Systematic Sampling. Cluster Sampling with Equal Probabilities:- One-Stage Cluster Sampling, Two-Stage Cluster Sampling, Designing a Cluster Sample. Sampling with Unequal Probabilities:- Sampling One Primary Sampling Unit, One-Stage Sampling with Replacement, Two-Stage Sampling with Replacement, Unequal-Probability Sampling Without Replacement, Randomization Theory Results and Proofs. Sampling distributions (The sampling distribution of the mean, variance and the proportion, the sampling distribution of the difference between means and between the proportions, the sampling distribution of the ratio of variances).

Math 335 Differential Equations (2) :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 214

Descriptions: Solutions of Differential Equations using Power Series Method: Solutions Near Ordinary, Regular Singular Points, Method of Frobenius. Bessel's Equation, Applications of Bessel Functions. Laplace Transform Methods: Laplace Transforms and Inverse Transforms, Impulses and Delta Functions. Linear Systems of Differential Equations: First-Order Systems and Applications, The Method of Elimination, Matrices and Linear Systems, The Eigenvalue Method for Homogeneous Systems, Nonhomogeneous Linear Systems. Numerical Methods: Euler's Method, A Closer Look at the Euler Method, The Runge-Kutta Method, Numerical Methods for Systems. Nonlinear Systems and Phenomena: Equilibrium Solutions and Stability, Linear and Almost Linear Systems, Ecological Models: Predators and Competitors, Nonlinear Mechanical Systems, Chaos in Dynamical Systems.

Math 336 Data Analysis by statistical Software :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 337

Descriptions: Introduction to data analysis. Introduction to software:- Introduction to types of data, study of qualitative and quantitative variable, Graphical representation of data, Sample studies for paired data, Correlation for qualitative and quantitative data. Remark: This course is based on SAS; SPSS; MINITAB or R.

Math 337 Hypotheses Tests :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 334

Descriptions: Introduction (revision on sampling distributions, parametric/non parametric tests, level of significance, null hypothese, alternative hypothese, types of a paramertic test) Tests of Hypotheses for a one population parameter (mean, variance and proportion). Tests of hypotheses for two population parameters (independent/ paired case). Chi square tests and applications. Testing Theory:- Statistical hypotheses, Testing a Statistical hypotheses, Losses and risks, Neyman pearson Lemma, The Power function of a test, Likelihood ratio test.

Math 338 Ordered Statistics :(2h lecture and 1h tutorial /Weekly)
Pre-requisite: Math 232

Descriptions: Introduction and preview. Basic distribution theory:- Distribution of an order statistic, Joint distribution of two order statistics, Some properties of order statistics, Distribution of the median, Range, and some other statistics., Discrete order statistics:- Single order statistic, joint probability mass function, Dependence structure, Distribution of the range, Geometric order statistics, Order statistics from a without-replacement sample. Order statistics from some specific distributions, Moment relations, Bounds, and approximations, Characterizations using order statistics.

Math 341 Data Structures :(2h lecture and 2h practical /Weekly)
Pre-requisite: Uni 102

Description: Topics covered include: information and meaning, data types: arrays, records, stacks, queues, trees, lists and linked lists, records and files. Data structure manipulation such as array manipulations, sorting, searching, trees and files manipulations. String processing and recursion manipulations. The data structures representation and manipulations are exercised using C++ or C# languages.

Math 342 Database Management Systems :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Uni 102

Descriptions: Basic principles of database management systems (DBMS) and of DBMS application development. DBMS objectives, systems architecture, database models with emphasis on Entity-Relationship and Relational models, data definition and manipulation languages, the Structured Query Language (SQL), database design, application development

tools, access methods interfaces, security, concurrency control and recovery, query processors and optimizers.

Math 343 Artificial Intelligence :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 217

Descriptions: Studying the foundations of Artificial Intelligence in today's environment and instilling an understanding of representations and external constraints with the idea of enabling a student to think creatively. There are many cognitive tasks that people can do easily and almost unconsciously but that have proven extremely difficult to program on a computer. Artificial intelligence is the problem of developing computer systems that can carry out these tasks. The course can focus on some central areas in AI such as: representation and reasoning, learning, AI languages such as Prolog and Lisp, expert systems, machine learning, robots, and natural language processing.

Math 344 Structural Programming :(2h lecture and 2h practical /Weekly)

Descriptions: The course teaches one of the structure languages in a way that emphasizes algorithms design using a structured, modular, and object-oriented approach. Then it studies recursion, introduces the abstract data type of lists, and shows how one can implement them in the used language using fundamental data structures. Introduction material on software engineering and program development. Topics include both the common heritage of the programming language (e.g. syntax, primitive types, equality, relational, and logical operators, arithmetic operations iteration, conditional expressions, functions, arrays, pointers, proper documentation techniques, testing and debugging, error handling and dynamic memory allocation, methods and the conventional standard libraries) as well as the introduction to object-oriented and unique aspects of programming with the used language. Completion of this class will prepare the student for advanced programming language.

Math 345 Operating Systems :(2h lecture and 2h practical /Weekly)
Pre-requisite: Uni 102

Descriptions: Principals of operating systems. The operating systems as a control program and as a resource allocator. The concept of a process and a concurrency problems. Synchronization, mutual exclusion, deadlock, Additional topics include memory management, file systems process scheduling threads and protection.

Math 346 Systems Analysis and Design :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Uni 102

Descriptions: Information requirements: Structuring of IT-based opportunities into projects; Project specification; Project prioritization; Analysis of project feasibility. Operational, Tangible costs and benefits (financial and other measures such as time savings), Intangible costs and benefits such as good will, company image: Technical; Schedule; Cultural (organizational and ethnic). Fundamentals of IS project management in the global context. Using globally distributed communication and collaboration platforms. Analysis and specification of system requirements; Data collection methods; Methods for structuring and communicating requirements; Factors affecting user experience; User interface design; System data requirements; Factors affecting security; Ethical considerations in requirements specification. Different approaches to implementing information systems to support business requirements: Packaged systems; enterprise; systems; Outsourced development; In-house development. Specifying implementation alternatives for a specific system. Methods and impact of implementation alternatives on system requirements specification. Different approaches to systems analysis and design: structured SDLC, unified process/UML, agile methods.

Math 348 Special issues in computer science (1) :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Uni 102

Description: Topics are selected from different areas in Computer Science that are not covered in the description of the courses listed in the curriculum. This course will cover subjects of recent

issues and trends in computer science and must cover one of the following subjects: Web-based system, computer data security, and human computer interaction.

Fourth Level

Math 400 Project of Research and Report: (2 h lectures /Weekly)

The project of research and report, to develop students to use their scientific knowledge, their ability to plan and execute an extended experimental or theoretical investigation and use all their communication skills to describe their results. To provide an understanding of some techniques of research, including the presentation of results. They should have produced an impressive report on their project and discuss its content with confidence

Math 411 Theory of Ordinary Differential Equations :(2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 214

Descriptions: Existence and uniqueness theory. Some concepts from real function theory. Fundamental of Existence and uniqueness theory. Dependence of solutions on initial condition and on functions. Existence and uniqueness theorems for systems. Higher-order differential equations. The theory of linear differential equations. Introduction. Basic theory of Homogenous linear systems. Further theory of the Homogenous linear systems. The non-homogenous linear systems. Basic theory of the n-th order homogeneous linear differential equations. The n-th order of non-homogenous linear equations .Sturm theory. System of linear-differential equations. Basic theory methods of solutions.

Math 412 Graph Theory: (2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 212 or Math 203

Descriptions: 1- Introduction to graph theory, Subgraphs, 2- spanning and induced subgraphs, 3- Walks, trails, and paths, 4- Isomorphisms, isomorphic invariants, 6- Simple graphs and its properties, 7- Deleting and adding verticies and edges. Operations on graphs, 8- Kinds of graphs, union, Join, and product of graphs, 9- Theorems and properties of Trees and planar graphs, 10- digraphs with loops, Directed graphs (Digraphs), redefine all concepts over digraphs such as directed walks, directed paths, 11- Graphs and Matrices, to represent graphs and digraphs as a matrix.

Math 413 Numerical Analysis (2) :(2h lecture and 2h practical /Weekly)
Pre-requisite: Math 313

Descriptions: (1) SOLVING NONLINEAR EQUATIONS: Locations of roots, Bisection method, fixed-point method, Method of false position, Newton-Raphson method, secant method, Chebyshev method, solving nonlinear systems of equations. (2) NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS OF INITIAL VALUE TYPE: Euler's method, Taylor's method, Runge - Kutta method, Predictor-Corrector methods, Solving systems of differential equations. (3) LEAST SQUARES APPROXIMATION: General least square method, Fitting of a straight line, Fitting of a parabolic curve, Fitting of a polynomial of degree k, Least squares method for continuous data, Approximation using orthogonal polynomials, Approximation of functions, Chebyshev polynomials, Expansion of functions using Chebyshev polynomials (4) EIGENVALUE PROBLEM : Eigenvalue of a matrix, Leverrier-Fadeev method to construct characteristic equation, Eigenvectors using Leverrier-Fadeev method, Power method for eigenvalues and eigenvectors - Fast Fourier transform (FFT) , (5) Applications using Cmputer Algebra System (CAS) packages.

Math 414 Functional Analysis: (2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 211

Descriptions: Metric Spaces: Definition and examples – open sets, closed sets the closure. 2- Normed Linear Spaces : Definition and topology of a normed space – examples – subspaces – sequences – bounded linear transformations – linear homeomorphisms – finite-dimensional

normed spaces. 3- Hilbert Spaces: symmetric (bilinear) forms and inner products – orthogonality and Gram-Schmidt orthonormalization process – adjoint operators – self- adjoint operators – positive operators – orthogonal projections.

Math 415 Lie Algebra (Math): (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 215

Descriptions: 1 – Basic concepts. 2 – Ideal and homeomorphisms. 3 – Solvable and nilpotent Lie algebras. 4 – Semi simple Lie algebras. 5 – Representation theory (module-Structure). 6 – Representation of sl (2) 7 – Root system. 8 – Manifold theory. 9 – Lie groups. 10 – Connection between Lie group and Lie algebra.

Math 416 Differential Geometry :(2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 218

Descriptions: [1] The theory of curves [(i) plane curves. (ii) space curves : arc – Length, curvature, torsion and Frenet's formulas] [2] The theory of surfaces in space: [(i) regular surface – tangent vectors and tangent plane at a point. (ii) Curves on a surface, first and second fundamental forms. (iii) Curvatures of surface. (v) Gauss equation and Christoffel symbols. (iv) Principal curvatures and lines of curvatures.

Math 418 Lattice Theory: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 212

Descriptions: Partially ordered, totally ordered and inductively ordered sets. Lattice and complete lattice. Sublattices and direct product of lattices. Lattices and ordered homomorphisms and the other kinds of homomorphisms. Distributive and Modular lattices. Complemented lattices. Boolean algebra. Applications in switching and logic circuits. Ideals and congruence relations.

Math 419 Topology (2): (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 316

Descriptions: Methods of generating topologies. Compact spaces
Connected spaces - Sequences in topological spaces- Convergence in topological spaces: by filter and nets - Fuzzy topological spaces.

Math 421 Operations Research :(2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 313, or Math 111 for Phys.

Descriptions: Linear Programming. Simplex method. Duality and sensitivity analysis. Transportation and assignment problems. Network models. Dynamic programming.

Math 422 General Relativity: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math.223

Descriptions: 1) Equivalence and covariance principles. 2) Tensor analysis. 3) Gravity as a metric phenomenon. 4) Einstein equation in vacuum. 5) Schwarzschild solution and black holes. 6) Perihilion shift and bending of light rays in gravitational fields. 7) Einstein equation in matter and cosmological models.

Math 423 Quantum Mechanics : (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 326

Descriptions: Problems with Classical mech. (Black body radiation, photoelectric effects, stability of Hydrogen atom). Old Mechanics and its problems. Uncertainty principle, Particle-Wave duality and Schrödinger equation. Some Math. Results and Ehrenfest th. (Contact with Classical Mech.). Solving Schrödinger equation for some constant potential. Schrödinger equation for the harmonic Oscillator. Schrödinger equation for the Hydrogen atom. Time independent perturbation theory.

Math 424 Advanced Mechanics : (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 326

Descriptions: Dynamics of rigid bodies: (Euler's case of free body motion. Explicit solution. Poinsot's geometric interpretation of the motion. Study of stability of uniform rotation. Lagrange's case of motion of a symmetric body. Separation of variables. Qualitative analysis of motion. Stability of standing gyroscope. Conditional integrable cases. Gyrostat. Integrable cases. Gyroscopic stabilization. Motion of a body in the field of a far Newtonian centre. Motion of a body not fixed from a point. Motion of a top on a horizontal plane. Attitude dynamics of Earth satellite (case of circular orbit). Analytical Dynamics(Hamilton's principle. Poincare-Cartan invariant. Canonical transformations. Hamilton-Jacobi equation. Separation of variables. Integrable and nonintegrable systems. Action-angle variables. Regular and chaotic motions).

Math 425 Hydrodynamics: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math.223

Descriptions: 1 – Fundamental principles. 2 – Some general theorems. 3 – Potential flows. 4 – Two-dimensional fluid motion. 5 – The viscous fluid.

Math 426 Modeling and Simulations: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math.214

Descriptions: Continuous time population models (Malthus, Logistic, Their equilibrium and stability) - Discrete time population models (Logistic, Ricker Their equilibrium and stability) Multi-species population models (Predator-prey, Competition, epidemics, fractals Equilibrium and stability). Space Shuttle motion. Tacoma bridge accident. Multiobjective optimization (crop spray, fishing fleets, radiotherapy etc…) Then student projects are done. Some applications of control theory.

Math 429 Partial Differential Equations : (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 214

Descriptions: Introduction to Partial differential equations – order –homogenous and non homogenous – degree-linear and nonlinear- Heat equation, Wave equation and Laplace's equation in both one and higher dimensions. Separation of Variables, boundary value problems, Fourier Series. Sturm-Liouville eigenvalue problems, eigenfunction expansions. Green's function methods. Fourier and Laplace Transform techniques. Applications.

Math 431 Analysis of Variance : (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 334

Descriptions: Overview of the basic concepts of experimental and observational studies (Factor-crossed and Nested factors- Treatments-Choice of treatment-Control treatment.) - Relation between analysis of variance and regression.- Difference between single –factor studies and multi-factor studies in analysis of variance.-Distinction between Fixed ANOVA model I and Random ANOVA model II (Assumption of the mathematical model- partition of total sum of squares- concepts of degree of freedom- mean square of errors and their expected-Sampling distribution of mean squares)-Estimation and Hypothesis testing of factor level means (single factor level mean-difference between two factor levels means-A contrast among factor level means- A linear combination of factor level means).-Need for using multiple comparison procedures (Tukey - Scheffe –Bonferroni-LSD)- Estimation and hypothesis testing of factor levels means using multiple comparisons.- Planning of sample size using power and estimation.-ANOVA Diagnostics and Remedial measures: Diagnosis of departure of ANOVA model (Non-Constancy of error variance-Non–Normality of error term-Non-Independence-Outliers-Omission of important independent random variable)-Tests of constancy of error variance (Hartley test-Barttlet test- Brown-Forsythe test).-Remedial measures (Weighted- Least squares-

Transformation of response variable-Box-cox procedure- Non-parametric test)- Effects of any remaining departures from model I and II on the inferences.

Math 432 Stochastic Processes: (2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 331

Descriptions: Introduction in Stochastic processes:- Notion of Stochastic Processes, Specification of Stochastic processes, Stationary Processes. Markov chain:- Introduction, Chapman–Kolmogorov Equations, Classification of States, Limiting Probabilities, Some Applications, Mean Time Spent in Transient States. The Poisson Process:- Counting Processes, Definition of the Poisson Process, Interarrival and Waiting Time Distributions, Further Properties of Poisson Processes, Conditional Distribution of the Arrival Times. Generalizations of the Poisson Process:- Nonhomogeneous Poisson Process, Compound Poisson Process, Conditional or Mixed Poisson Processes. Continuous-Time Markov Chains:- Introduction, Continuous-Time Markov Chains, Birth and Death Processes, The Transition Probability Function, Limiting Probabilities, Time Reversibility, Uniformization, Computing the Transition Probabilities. Introduction to Renewal Theory and Its Applications.

Math 433 Nonparametric Statistics: (2 h lectures and 1h tutorial /Weekly)

Descriptions: Concept of nonparametric statistics, Statistical tests based on the binomial distribution (binomial test and estimation of ratio, Quantile test, Tolerance limits), Contingency tables in (median tests, measures of dependence, Chi-square tests, Cochran test for related observations), Some nonparametric tests that depend on ranks (two independent samples, Several independent samples, Test for equal variances, Measures of rank correlations-nonparametric regression methods, Several related samples, Tests of randomization), Tests of the Kolmogorov-Smirnov type (the Kolmogorov goodness of fit tests, Goodness of fit tests for families of distributions).

Math 434 Regression Analysis: (2 h lectures and 2h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Linear regression with one independent variable:- Relations between variables, Regression models and their uses, Regression model with distribution of error terms unspecified, Estimation of regression function, Estimation of error terms variance σ^2, Normal error regression model. Inferences in regression analysis:- Inferences concerning β_1, Inferences concerning β_1, Some considerations on making inferences concerning β_0 and β_1, Interval estimation of $E(Y_h)$, Prediction of new observation, Considerations in applying regression analysis, Case when X is random, Analysis of variance approach to regression analysis, Descriptive measures of association between X and Y in regression model. Aptness of model and remedial measures:- Residuals, Graphic analysis of residuals, Tests involving residuals, F test for lack of fit, Remedial measures and Transformations. Simultaneous inferences and other topics in regression analysis:- Joint estimation of β_0 and β_1, Confidence band for regression line, Simultaneous estimation of mean responses, Simultaneous prediction intervals for new observations, Regression through the origin, Effect of measurement errors, Weighted least squares, Inverse predictions and Choice of X levels. Matrix approach to simple regression analysis:- Simple linear regression model in matrix terms, Least squares estimation of regression parameters, Analysis of variance results, Inferences in regression analysis, Weighted least squares and Residuals. Introduction to Multiple linear regression.

Math 435 Reliability Theory: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 231

Descriptions: Introduction to reliability theory. Network modeling and evaluation of simple systems:- Network modeling concepts, Series and Parallel systems, Series-parallel systems, Partially redundant systems, Standby redundant systems. Network modeling and evolution of complex systems:- Modeling and evolution concepts, Conditional probability approach, Cut set method, Tie set method, Event trees. Probability distributions in reliability evaluation:- General reliability functions, Evaluation of the reliability functions, Shape of reliability functions, The Poisson distribution, The normal distribution, The exponential distribution, The Weibull

distribution, The gamma distribution. System reliability evaluation using probability distributions:- Series and parallel systems , Partially redundant systems, Mean time to failure, Standby systems and Wearout and component reliability.

Math 436 Time Series and Forecasting: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math.231

Descriptions: Data sources: Historical, the Web. Checking time series components: trend, seasonality, cyclical. Transformation: Differences method, Seasonal adjustment. Forecasting:- How to forecast future, adequacy of a forecast, regression forecasting against time series forecasting, some adequacy measures (MAD, MSE, MAPE). Decomposition and smoothing of times series: moving averages, exponential smoothing. Box-Jenkins models ARIMA(p,d,q):- Autocorrelation and partial autocorrelation functions, identification of appropriate model, dealing with seasonal time series, fitting models to real and simulated data sets. Diagnostic checks on the residuals. Case studies: training on how to analyze real life data sets using the statistical package MINITAB, write reports.

Math 441 Software Engineering: (2 h lectures and 1h tutorial /Weekly)

Descriptions: Software processes: Software life-cycle and process models; process assessment models; software process metrics. Software requirements and specifications. Software design: Fundamental design concepts and principles; software architecture; structured design; object-oriented analysis and design; component-level design; design for reuse. Software validation: Validation planning; testing fundamentals; unit, integration, validation, and system testing; object-oriented testing; inspections. Software evolution: Software maintenance; characteristics of maintainable software; reengineering; legacy systems; software reuse. Software project management. Component-based computing: Fundamentals; basic techniques; applications; architecture of component-based systems; component-oriented design; event handling; middleware.

Math 442: Neural Networks: (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math 345

Descriptions: Introduction - Simple neural nets for pattern classification - Back propagation neural net and radial basis functions - Pattern association - Neural nets based on competition - Other neural networks - Applications of neural networks.

Math 443 Expert Systems : (2 h lectures and 1h tutorial /Weekly)
Pre-requisite: Math.345

Description: Introduction to knowledge based systems, regular programming and knowledge engineering, problem solving, knowledge types, nature of experience, knowledge representation, knowledge base, knowledge representation strategies, inference networks, knowledge frameworks, expert systems relationships, knowledge systems construction, role of micro systems and problem selection, development of expert systems models. Applications using expert systems.

Math 444 Computer Graphics :(2 h lectures and 2h practical /Weekly)

Descriptions: Overview of Computer Graphics - Basic principles - Graphics Systems and Primitives – Library / system support for graphics - Point plotting - Straight line drawing - Curved line drawing - Two-Dimensional Graphics - Mathematical background and Coordinate System – illumiuation, shoding, renderg and texturing - Transformations (Translation, Scaling, Rotation) – Animation -Approaches (segments vs. direct) - Filling (Painting) – Windowing – Clipping. Advanced software tools.

Math 445 Design and Analysis of Algorithms :(2 h lectures and 2h practical /Weekly)
Pre-requisite: Math 344

Descriptions: Building existing skills in mathematical analysis of algorithm complexity, including lower bounds, worst-case and average-case behavior. General techniques in algorithm design (such as divide and conquer, greedy and dynamic programming approaches) in the context of problem domain like graph, sorting, searching and optimization problems. Introduction the topic of NP-complete problems.

Math 446 Image Processing: (2 h lectures and 1h tutorial /Weekly)

Descriptions: 1- fundamentals (What is digital image processing-Digital image representation-Image types). 2- Intensity transformatins function(Histogram processing- Spatial filtering). 3-Image restoration(A model of the image degradation- Noise models - Direct inverse filtring). 4-Color image processing(Color image representation-Converting to other color spaces- Color transformatins). 5- Image compression(Coding redundancy- Interpixel redundancy- JPEG compression). 6- Image segmentation(Point, line and edge detection – Thresholding - Region-Based segmentation). 7- Wavelets(The Fast wavelet Transform- Wavelet decomposition structures- Wavelet in image processing).

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Physics Department

First Level

Phys 101 Properties of Matter and heat: (2h lecture, 2h practical and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts in Thermal physics and Properties of Matter. The thermal physics course includes; The zeroth law of Thermodynamics. Thermal Expansion of Solids and Liquids. Heat and Thermal Energy. Heat Capacity and Specific heat-Latent heat.
The Properties of matter course includes; Units and Dimensions. Vectors, Elasticity Oscillatory Motion.Fluids (Static and Dynamic).Surface Tension.

Phys 102 Electricity, Magnetism and Optics: (2h lecture, 2h practical and 1h tutorial/Weekly)

Electricity and Magnetism course includes Electric Force, Electric Field. Gauss's law. Electric potential. Capacitance and Dielectric. Electric current and Ohm's law, Work, power and energy. Magnetic fields. Source of the magnetic field. Biot savart and Ampers law. Faraday law, Inductance.
Optics course includes Nature of light and the law of Geometric optics, propagation of light, deviation of light by prisms and dispersion, image formation.

Phys 103 Electric Circuits: (2h lecture, 2h practical and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of electric circuits. The course includes Definitions and Circuit Parameters, Sinusoidal Current and Voltage, Complex numbers, Complex Impedance and Phasor Notation, Series and Parallel Circuits, Power and Power Factor Correction, Series and Parallel Resonance, Mech Current Network Analysis, Node Voltage Network Analysis, Mutual inductance, Fourier Method of waveform analysis.

Phys 104 Thermodynamics: (2h lecture, 2h practical and 1h tutorial/Weekly)

This course aims at introducing a clear understanding of the basic concepts of Thermodynamics. The course includes; Thermodynamic systems, Equations of state, work, The first law of thermodynamics, Some consequences of the first law, Changes of phase, The second law of thermodynamics, Entropy, combined first and second laws, some engineering applications of thermodynamics.

Second Level

Phys 201 Practical Physics (1): (4h practical/Weekly)

The Laboratory is designed to illustrate physical principles and to develop experimental skills; and how to emphasize proper report writing. The course includes; Experiments dealing with the basic laws of mechanics, Vibrational and circular motion, Fluids, elasticity, Feat, thermal properties of materials, Error analysis and the concept of computer-controlled experiments.

Phys 202 Practical Physics (2): (4h practical/Weekly)

The Laboratory is designed to illustrate physical principles and to develop experimental skills; and how to emphasize proper report writing. The course includes; Experiments dealing with the basic laws of Physical optics (As; Young Double Slit, Mickelson's Interferometer, Abbe's Refractometer, Polarization of Light, Diffraction Grating, Newton's Rings), Alternating Current and Electronic Measurements and Instrumentation.

Phys 209 Atomic and Modern Physics :(2 h lectures and 1h tutorial/Weekly)

This course aims to introduce and explain the principles, models, and methods required to understand the behavior of atoms and modern physics. The course includes; The special theory of relativity, Galilean transformations and their limitations, Einstein's postulates and Lorentz transformations, Length, time and simultaneously in relativity, Mass and momentum in relativity, Relativistic Mechanics, Mass and Binding Energy. Black body radiation and Quantum hypothesis. Photoelectric effect. Compton effect. X-rays, old quantum mechanics and Bohr model of H atom. Vector atom model. Normal Zeeman effect, anomalous Zeeman effect and Stark effect. Tutorial: 1h/W

Phys 210 Atomic Physics :(2h lecture and 1h tutorial/Weekly)

This course aims to introduce and explain the principles, models, and methods required to understand the behavior of atoms. The course includes: Black body radiation, Rayleigh-Jeans law, Planck's law. Photoelectric effect. Compton effect.X-rays { production of X-rays, continuous X-rays, characteristic x-rays, Moseley's law – Diffraction and absorption of x-rays}, Bohr model of H atom, energy level diagram, spectral series of H atom, H like ions. Wilson-Sommerfeld elliptical orbits {fine structure, degenerate orbits, mass relativistic effect, energy level diagram, selection rule}, Vector atom model. Normal Zeeman effect.

Phys 211 Vibration and Waves: (2h lecture and 1h tutorial/Weekly)

This course aims at introducing a clear understanding of the basic concepts of Vibration and Waves. The course includes; Periodic motions, The Superposition of periodic motions, The free vibrations of the physical system, Forced vibrations and Resonance, Normal mode of Continuous System, Doppler effect.

Phys 212 Astronomy and Physics of Atmosphere :(2 h lectures and 1h tutorial/Weekly)

This course is aiming at introducing. The concept of Astronomy in order to be award with the knowledge of the following: Central Forces and Planetary Motion, Planetary orbits and Kepler's Laws, The planets in the Solar system, The Earth and Its Atmosphere, The Earth's Atmosphere, Planetary atmosphere, Equilibrium temperatures, Hydrostatic equation, Adiabatic lapse rate.

Phys 213 Nuclear physics (1) :(2h lecture and 1h tutorial/Weekly)

This course aims to introduce and explain the principles models and methods required for understanding the properties of the nucleus. The course includes; Structure of the nucleus: Basic properties of the nucleus Binding energy of the nucleus, Nuclear stability, Liquid-Drop model, Semi-empirical mass formula. The decay of the nucleus: The law of radioactive decay, Natural radioactivity and Alpha decay, Beta decay, Gamma decay, Interaction of Nuclear radiation with matter. Detectors. Accelerators.

Phys 214 Classical Mechanics :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the structure and fundamental principles of Classical Mechanics. The course includes: Coordinate Systems, Mechanics of a Single Particle and of Systems of Particles, Motion in a Central Force Field, Oscillations, Collisions of Particles, Moving Coordinate Systems, and Motion of a Rigid Body

Phys 215 Physics of Elasticity :(2h lecture and 1h tutorial/Weekly)

The course aims at introducing the concept of elasticity. It consists of; The Concept of the Force, plane stress, plane strain and Different Physical Properties of Material, The Mechanism of Fracture of Different Material, and Fundamental of Fracture Mechanics, Fatigue, Creep. Torsion and Twisting of the metallic beam.

Phys 220 Modern Physics :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 213

This course aims at developing a clear understanding of the basic concepts of modern physics. The course includes: The special theory of relativity: Galilean transformations and their limitations, Einstein's postulates and Lorentz transformations, Length, time and simultaneously in relativity, Mass and momentum in relativity, Relativistic Mechanics, Mass and Binding Energy, Experimental verification of the relativity theory, The concepts of waves and particles: Black-body radiation, The photo-electric effect, The continuous X-ray spectrum, The photon, The Compton effect, The de-Broglie hypothesis, The diffraction of waves and particles, Introductory quantum mechanics, Bohr's principle of complementarity, Wave-packet description of material particles, Statistical interpretation of the wave function, Heisenberg uncertainty principle.Schrödinger wave equation, Particle in a one-dimensional potential well.

Phys 221 Physical Optics :(2h lecture and 1h tutorial/Weekly)

An understanding of the basic physical optics and describes the behavior and properties of light and interaction of light with matter. The course includes; the wave theory of light, Interference of two beams of light, Interference with multiple-beams, Diffraction of light, Polarization of light, Dispersion and absorption of light.

Phys 222 Principals of Electromagnetic Theory: (2h lecture and 1h tutorial/Weekly)

This course aims at studying the Electromagnetic theory from the Electrostatic, magnetostatic and Electromagnetic relations. The course includes: Vector Analysis, Coulomb's Law and Electric Field, The Electrostatic Potential, Electrostatic Dipole, Dielectric Polarization, Poisson and Laplace Equations, Biot-Savart Law and Magnetic Field Potential, Magnetic Vector Potential and Induction, Magnetic Dipole, Poisson and Laplace Equations for Magnetic Potentials, Electromagnetic induction and Faraday's law, Maxwell’s equations, Electromagnetic wave equations, electromagnetic plane wave propagation.

Phys 223 Analytical Mechanics :(2 h lectures and 1h tutorial/Weekly)

This course aims at introduces a clear understanding of the basic concepts of Analytical Mechanics. The course includes; Lagrangian Mechanics, Hamilton equations of motion, canonical transformations, Hamilton- Jacobi theory, canonical perturbation theory, introduction to the Lagrangian and Hamiltonian formulations for continuous and fields, Poisson brackets. Tutorial: 1h/W

Phys 224 Fluid Mechanics: (2h lecture and 1h tutorial/Weekly)

The course aims at introducing the concept of fluid mechanics. It consists of: The Concept of the Stream line and turbulent flow, Bernoulli's equation, Poiseulle's law, Power dissipation. Reynolds's number, cardiovascular system, viscous drag forces Stock's law and centrifugation. Tutorial: 1h/W

Phys 225 Sonic And Ultrasonic :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Ultrasonic. The course includes; Velocity of sound in fluids, Acoustic intensity and impedance, Decibel scales. Doppler Principles, Ultrasonic generators and receivers, Detection of Ultrasonic Waves, Ultrasonic Imaging.

Phys 228 Alternating Current and Electric Circuits:(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of alternating current and electric circuits. The course includes: Definitions and Circuit Parameters, Analysis of circuits with non-sinusoidal A.C. waveform using Graphical solution, Average and effective values, Sinusoidal Current and Voltage, Complex numbers, Complex Impedance and Phasor Notation, Series and Parallel Circuits, Power and Power Factor Correction, Series and Parallel Resonance, Mech Current Network Analysis, Node Voltage Network Analysis, Mutual inductance, Fourier Method of waveform analysis.

Bio-Phys 210 The Electricity in Bio-systems:(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts in physics of electricity in bio-systems. The course includes; Membrane potentials, Nerve Impulses, Electromagnetic Blood Flow-meters, Effects of electric current in the human Body, Electrical conductivity of the cellular membrane at rest, Tissues conductivity, Medical electronics.

Bio-Phys 211 Introduction in Biophysics:(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of biophysics. It includes; Experimental studies on living cells, Electromagnetic waves, Spectrum and range and their applications, Photobiological process, Acoustical phenomena of biophysical interest.

Third Level:

Phys 301 Practical Physics (3): (6h practical/Weekly)

The Laboratory is designed to illustrate physical principles and to develop experimental skills; The course includes; Selected experiments on topics of Solid state, advanced optical and Electronics, Digital circuits (As: bipolar junction, bipolar junction transistors. oscillators. logical circuits).

Phys 302 Practical Physics (4): (6h practical/Weekly)

The Laboratory is designed to illustrate physical principles and to develop experimental skills;
The course includes; Selected experiments on topics of Electronics and Digital circuits (As: Electronics: the operational amplifier, Uniboplar transistor, Photodiode, phototransistor and solar cell, work function and contact potential, a Light emitting diode, Digital: operation of various types of bistables or flip-flops. Also, to design counters).

Phys 310 Statistical Mechanics (1): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 104

The course is devoted to study the Statistical thermodynamics. A basic theory is given. Different examples and problems are presented. The course includes: kinetic .theory of an ideal gas, the distribution of molecular velocities, Transport phenomena, The maxwell-boltzmann statistics, applications of the boltzmann statistics, quantum statistics , fluctuations.

Phys 311 Solid State (1): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 210

This course aims at introducing a clear understanding of the basic concepts of physics of Solid Materials. The course includes; Crystal Structure, Crystal Diffraction and Reciprocal Lattice, Diffraction Techniques, Crystal binding, Ionic crystals, Imperfections in crystals, Diffusion.

Phys 312 Physics of Reactors and Neutrons: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 213

This course aims at developing a clear understanding of the basic concepts of Physics of reactors and neutrons. The course includes: Neutron and its Interaction with Matter, differential Scattering Cross-section, Nuclear Fission, The Fission Chain Reaction and Nuclear Reactors, Slowing Down of Neutrons, Neutron Moderation by Inelastic Scattering, Thermal Neutron Scattering, The scattering law.

Phys 313 Quantum physics: (2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Quantum Physics. The course includes; Early Days of Quantum Theory and the Wave Nature of Electrons,. The Schrödinger Equation and Operators in Quantum Mechanics, Particles in Potential Wells and Tunnelling through

Barriers, The Harmonic Oscillator: A Model for Molecular Vibrations, The Rigid Rotator: A Model for Molecular Rotations and the Angular Momentum, The Hydrogen Atom: Energy Levels and Atomic Orbitals, The Electron Spin and Related Phenomena, Chemical Bonding: Molecular, Orbitals and Energy Levels of Electrons in Molecules, Perturbation Theories and Selection Rules for Transitions, Elements of Molecular Spectroscopy and Lasers, Symmetry Elements of Molecules and Group Theory, Weak Bonds and the Molecules of Life.

Phys 314 Quantum Mechanics (1): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 220

This course aims at developing a clear understanding of the basic concepts of Quantum Mechanics. The course includes; Wave Mechanics: Schrödinger wave equation in momentum space. One-Dimensional problems: Infinite and finite potential well, Tunneling effect, Radioactive decay and penetration of potential barrier, The periodic potential, Simple harmonic oscillator, The Morse potential. Three-Dimensional Problems: Solution of Schrödinger equation in cylindrical coordinates, Solution of Schrödinger equation in spherical coordinates, Space rotator, Solution of the harmonic oscillator in spherical coordinates, The Hydrogen atom. Time-Independent Perturbation Theory.

Phys 315 Mathematical Physics (1):(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Math 210

This course aims at introducing students to some of the basic mathematical physics of Special function and techniques relevant to undergraduate physics further develop student's skill in solving problems. The course includes; Gamma and Beta functions, The hypergeometric Equation, the confluent hypergeometric function, The Legendre functions, Bessel functions, Laguerre Polynomials, Hermite polynomials, other special function.

Phys 316 Advanced Optics: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 221

This course aims at developing the basic concepts of physical optics and their applications. The course includes; The origin of the refractive index, Dispersion, The electromagnetic character of light, Absorption, Scattering of light, interference, Polarization of light, optical activity and birefringence.

Phys 317 Physics of Metals :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of physics of Metals. The course includes; Free-Electron Theory of Metals. The crystal structure of Metals and Energy Bands in Metals.Crystallization. Mechanical properties, Strain Hardening and Recrystallization, The Structure of Alloys, Constitutional Diagrams, Heat Treatment and Metal Technology.

Phys 320 Computer Programming :(2h lecture and 1h tutorial/Weekly)

This course introducing the concept of programming with Fortran Language and to give practice in the use of the language to solve scientific problems. The course includes: Elements of statements, Mathematical Functions, Arithmetic Assignment Statements, How to write the program Statements? Input and Output Statements, Application for FORTRAN 77, Transfer of control, (Arithmetic and logical IF Statement, Goto ,…), The subscripted variables and dimension, Examples of the Subscript Notation, The dimension Statement and other information, The DO statement, Explicit uses of DO Loop and Dimension, Read Statement of one data item per line, Read Statement for more than one data item per line, Implied DO List.

Phys 321 Electronics Circuits :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 103

This course aims at developing a clear understanding of the basic concepts of electronics circuits. The course includes; Quadra poles (two-port networks) and equivalent circuits, Semiconductor materials and Pn junctions, Bipolar Junction Transistor, Bipolar Transistor Biasing, Bipolar transistor as a small signal amplifier, Operational Amplifiers.

Phys 322 Non-Crystalline Material :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 311

This course aims at developing a clear understanding of the basic concepts of Non-Crystalline material. The course includes; Nature and structure of glass, Electrical properties, Thermal properties, Viscosity Density and molar volume, Special types of glassy materials.

Phys 323 Nuclear Physics (2):(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 213

This course aims to introduce and explain the principles, models, and methods required to understand the behavior of nuclei. The course includes; Nuclear Models: Single-Particle potential; Analysis of shell Model predictions. Single-particle Model, Magnetic moment; Nuclear Rotational Motion nuclear moments; Optical Model, Nuclear Forces, properties of the nuclear force, The exchange force Model, Nuclear Reactions, Nuclear Fusion.

Phys 324 Electrodynamics (1): (2h lecture and 1h tutorial/Weekly)

This course an understanding of the development of elementary ideas of electromagnetism up to Maxwell's equations and the existence of electromagnetic waves. The course includes; Conservation Laws, Charge and Energy, Momentum, Electromagnetic Waves, Waves in One Dimension, Electromagnetic Waves in Vacuum, Electromagnetic Waves in Matter, Absorption and Dispersion, Guided Wave, Potentials and Fields, The Potential Formulation, Continuous Distributions, Point Charges, Radiation, Dipole Radiation.

Phys 325 Mathematical Physics (2): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 315

This course aims at introducing students to some of the basic mathematical physics of Partial Differential Equations and techniques relevant to undergraduate physics, further develop students skill in solving problems. The course includes; Concepts and Definitions, Mathematical Models. Classification of Second-order Equations, Second-order Equations in Two Independent Variables.The Cauchy Problem, Homogeneous Wave Equation.Initial-boundary Value Problems.Nonhomogeneous Boundary Conditions.Finite String with Fixed Ends, Nonhomogeneous Wave Equation. Fourier's Series, Method of Separation of Variables, The Heat Conduction Problem. Existence and Uniqueness of Solution of the Heat Conduction Problem, The Laplace and Beam Equations, Nonhomogeneous Problems, Laplace and Fourier Transforms.

Phys 326 Fine Magnetism :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Fine magnetism. The course includes; Introduction and review of basic formulas, Class of magnetic materials, Ferromagnetism, Ferrimagnetism, Antiferromagnetism. Magnetic properties of electrons. Magnetic moments of free atoms and ions, Structure of unfilled shells, Hund's rules, Electronic configurations. Langevin diamagnetism equation, Quantum theory of paramagnetism, Rare earth ions, Iron group ions, Crystal field splitting, Quenching of the orbital angular momentum. Ferromagnetism, antiferromagnetism and spin wave, Magnetic domains. Magnetic resonance and its applications.Magnetic resonance, the resonance phenomenon, Magnetization, Nuclear magnetic resonance, Calculating transition energy.

Phys 327 Polymer Physics: (2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Polymer physics. The course includes An introduction to polymers, Polymer structure, Physical states of polymers, Thermal properties of polymers, Mechanical properties of polymers, Electrical properties of polymers, Viscoelasticity of polymers, Relaxation properties of polymers, Glass-transition in polymers, Rheology of polymers.

Phys 328 Nonlinear physics: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 315

This course aims at developing a clear understanding to explain the main principles of nonlinear physics. One-Dimensional Flows, A Geometric Way of Thinking, Fixed Points and Stability, Population Growth , Linear Stability Analysis, Existence and Uniqueness, Impossibility of Oscillations, Potentials, Bifurcations, Saddle-Node Bifurcation, Transcritical Bifurcation, Laser Threshold, Pitchfork Bifurcation, Overdamped Bead on a Rotating Hoop, Imperfect Bifurcations and Catastrophes, Two-Dimensional Flows, Linear Systems,Classification of Linear Systems, Phase Plane, Phase Portraits, Fixed Points and Linearization, Rabbits versus Sheep, Conservative Systems, Reversible Systems, Pendulum, Index Theory, Limit Cycles, Ruling Out Closed Orbits. Weakly Nonlinear Oscillators. Nonlinear waves in physics, KdV equation and soliton solutions, travelling wave solution to some nonlinear PDE.
Introduction to similarity and lie group analysis, Inverse scattering methods.

Phys 329 Molecular Spectroscopy :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 210

This course aims at developing a clear understanding of the basic concepts of Molecular Spectroscopy, The course includes; Basic Elements of Spectroscopy. Microwave Spectroscopy. Infra-Red Spectroscopy, Raman spectroscopy, Electronic Spectroscopy of Molecules, Spin Resonance Spectroscopy.

Phys 335 Electronics Circuits and Digital electronics :(2 h lectures and 2h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of electronics circuits and digital electronics. The course includes:
I- Semiconductor materials and Pn junctions, Bipolar Junction Transistor, Transistor operation characteristics, Biasing, Bipolar transistor as a small signal amplifier, Operational Amplifiers. Applications.
II- Digital Concepts: Number systems and codes.- Logic Gates. AND - OR – Not – NAND, Nor, XOR, XNOR, Boolean Algebra, Logic circuits Design and application, AND – OR LOGIC, ALL-NAND Gates, or-AND Logic, ALL-NOR Gates, Application. Applications.

Bio-Phys 301 Practical Bio-Physics (1) :(6h practical/Weekly)

The Laboratory is designed to illustrate Bio-physical principles and to develop experimental skills; and how to emphasize proper report writing. The course includes selected experiments on topics of Molecular Biophysics.

Bio-Phys 302 Practical Bio-Physics (2): (6h practical/Weekly)

The Laboratory is designed to illustrate Bio-physical principles and to develop experimental skills; and how to emphasize proper report writing. The course includes selected experiments on topics of Health Physics.

Bio-Phys 310 Biophysical Radiation: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 220.

This course aims at developing a clear understanding of the basic concepts of Biophysical Radiation. The course includes; Mater, Energy and radiation, Interaction of radiation with mater, dosimetry of ionizing radiation radiobiology; “Biological effects of radiation exposure on human cells”, Production of radionuclides used in nuclear medicine, Nuclear magnetic resonances (NMR).

Bio-Phys 311 Molecular Biophysics :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Molecular Biophysics. The course includes; Physical methods of Determining the size and shape of molecules, Intermolecular Forces, Absorption spectroscopy and molecular structure.

Bio-Phys 315 Biomechanics :(2h lectures and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Biomechanics. The course includes: Testing the mechanical properties of biological materials, The Newtonian fluid. Viscoelasticity, Blood Rheology, Laminar flow, Red blood cells and their deformabi1ity RBC ' s dimensions and shape, The flow properties of suspended particles.

Bio-Phys 321 ionizing radiation :(2 h lectures and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Health Physics. The course includes; Ionizing Radiation Dosimetry standards, Exposure Dose measurement, Ionizing chamber , Bragg-Gray principle, Kerma, specific gamma ray emission, Dosimetry of internally deposited radioisotopes, Basic ionizing radiation safety criteria. Dose measuring instruments,

Bio-Phys 322 Bio-Energy :(2h lecture and 1h tutorial/Weekly)

This course aims at introducing the principles and applications of Bio-energy. The course includes; Energy and the Biological world, photosynthesis, Respiration, Phosphorylation, DNA and RNA, Metabolism and Catabolism.

Fourth Level

Phys 400 Research Project and Essay in physics: (2h lecture/Weekly**)**

The project of research and report, to develop students to use their scientific knowledge, their ability to plan and execute an extended experimental or theoretical investigation and use all their communication skills to describe their results. To provide an understanding of some techniques of research, including the presentation of results. Students should have obtained an appreciation of research methodologies gained under individual supervision; ability to design and execute a project, write a report and give a talk on it. The student chooses the project in consultation with a member of staff. The subject of the project may be experimental physics or theoretical physics. They should have produced an impressive report on their project, which they can show at career interviews and discuss its content with confidence.

Phys 401 Practical Physics (5): (6h practical/Weekly)

The Laboratory is designed to illustrate introduction for nuclear Experiments, Electronic Experiments, Polarization in Optics and Microwave, Solid State Experiments, Simulation for physics Experiments Using the Computer.

Phys 402 Practical Physics (6) :(6h practical/Weekly)

The Laboratory is designed to illustrate introduction for nuclear Experiments, Electronic Experiments, Diffraction in Optics and Microwave, Solid State Experiments, Simulation for physics Experiments Using the Computer.

Phys 403 Experimental Physics :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the experimental techniques of physics. The course includes; Errors of observation, Scientific Foundations of vacuum technique, Electron microscope, Applied emission spectroscopy, photography of the spectrum. Tutorial: 1h/W

Phys 405 Research Project and Essay in Physics (1h lecture/Weekly**)**

The project of research and report, to develop students to use their scientific knowledge, their ability to plan and execute an extended experimental or theoretical investigation and use all their communication skills to describe their results. To provide an understanding of some techniques of research, including the presentation of results. Students should have obtained an appreciation of

research methodologies gained under individual supervision; ability to design and execute a project, write a report and give a talk on it. The student chooses the project in consultation with a member of staff. The subject of the project may be experimental physics or theoretical physics. They should have produced an impressive report on their project, which they can show at career interviews and discuss its content with confidence.

Phys 410 Laser and its Applications :(2 h lectures and 1h tutorial/Weekly)

The course introduces the students to fundamentals, operation and applications of the laser. The course includes; Quantum transition in an atomic system, Amplification of electromagnetic wave in an optical cavity, Population inversion (three-level and four-level energy system), Basis of laser operation, Characteristic of laser light, Some types of laser sources-Axial modes of laser, Modifying the laser output, Applications of laser (in industry, in optical information and storage, in medicine, in military).

Phys 411 Semiconductors :(2 h lectures and 1h tutorial/Weekly)

This course aims to learn about the physics and applications of Semiconductors, The course includes; The crystal structure of Semiconductors and Energy bands in Semiconductors, Properties of Semiconductors, The P – N junction, Semiconductors Devices.

Phys 412 Quantum Mechanics (2) :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 314

This course aims at developing a clear understanding of the basic concepts in physics of Quantum Mechanics. The course includes; Approximation Methods, The Variational Method, Zemman Effect, Time-dependent perturbation theory, Electromagnetic radiation field, Frequency bands, Spin, Scattering in three dimensions, Resonances, Ram Sauer Effect, Born Approximation.

Phys 413 Statistical Mechanics (2):(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 310

This course aims at developing a clear understanding of the basic concepts of Statistical Mechanics. The course includes; Density Operators, The Symmetry Character of Many-Particle Wavefunctions, Grand Canonical Description of Ideal Quantum Systems. The Ideal Bose Gas.Ideal Fermi Gas, Applications of Relativistic Bose and Fermi Gases. Real Gases, Classification of Phase Transitions, The Models of Ising and Heisenberg.

Phys 414 Mathematical Physics (3): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 325

This course aims at introducing; students to some more advanced mathematical concepts that are used in undergraduate physics courses and to develop further their problems solving skill. The course includes Integral Equations, Their Origin and Classification. Modeling of Problems as Integral Equations.Volterra Integral Equations, The Green's Function. Fredholm Integral Equations. The existence of the Solutions: Basic fixed Point Theorems. Complex Variables, Analytic Function.Integrals. Series Representation of Analytic Function, Residues and Poles.

Phys 415 Nuclear Physics and Elementary Particle:(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 312

This course aims to introduce and explain more advanced models, and methods required to understand the behavior of nuclei. The course includes, Fermi theory of beta decay; angular momentum and Parity selection rules; comparative half-life and Forbidden decays; Neutrino Physics, Nuclear spin and moments; hyperfine structure, Meson physics, Yukawa's Hypothesis; properties of Pi mesons,. Elementary particle dynamics, relativistic kinematics and bound states. Electrodynamics of Quarks and Hadrons, Quantum Chromodynamics, Weak Interactions, Gauge theories.

Phys 417 Digital electronics :(2h lecture and 1h tutorial/Weekly)

Pre-requisite: Phys 321

This course aims at developing a clear understanding of the basic concepts of digital electronics. The course includes; Number systems and codes. - Logic Gates. Design with AND-OR logic and ALL NAND. Design with OR-AND logic and ALL NOR. Logic Functions, Adders. Comparators. Encoders and Decoders, Multiplexers and De-Multiplexers, Flip-Flop and Related Devices, Counters, Design of sequential circuits, counter applications.

Phys 418 Renewable Energy:(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Renewable Energy. The course includes; Solar Energy and Sun Construction, Thermal Radiation and Black Body Radiation, Sun-Earth Astronomical Relations: Earth's Orbit, The Eccentricity correction factor, The Solar Day, Seasons of year, Position Of Sun Relative To Horizontal Surface, Position Of Sun Relative To Inclined Surfaces. Terrestrial Solar Insolation: Structure of the Earth's Atmosphere, The Troposphere Region, The stratosphere Region, The Mesosphere Region, The Thermosphere Region, and the variation of molecular weight with altitude, Aerosols, Effect of Altitude on Pressure and Density.

Phys 419 Quantum Electronics :(2 h lectures and 1h tutorial/Weekly)
Pre-requisite: Phys 314

This course aims at developing a clear understanding of the basic concepts of Quantum electronics. The course includes: Crystal structures, Translational Reciprocal lattice. X-ray scattering, Bragg law, The Maxwell- Boltzmann, Bose- Einstein, and Fermi- Dirac statistics, Band Theory of Solids: Properties of semiconductors, Lattice vibration and thermal properties of crystals, Transport properties, Collision processes in solids- relaxation time.

Phys 420 Solid State (2): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 311

This course aims at developing a clear understanding of the advanced principle of solid State physics.The course includes; Lattice vibrations, free electron model, Energy bands in solids, Dielectric and optical properties of solids, polarizability.

Phys 421 Elementary Particle :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 323

In this course, the student extrapolates his knowledge about the matter. Presumably, the student has to know about the structure of the atom and the nucleus. Particle Physics impresses the discussion of the substructures of the particles in the nuclei (nucleons). Such kind of discussion needs to know elementary particle dynamics, relativistic kinematics and bound states. The Feynman Calculus Quantum Electrodynamics, Electrodynamics of Quarks and Hadrons, Quantum Chromodynamics, Weak Interactions, Gauge theoriesm.
Phys 422 Electronics :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 103

This course aims at developing a clear understanding of the basic concepts of electronics. The course includes; I- Digital electronic concepts, Number systems and codes, Logic gates, Logic circuit Design, Adders, Comparators, Multiplier, Demultipliers, Flip-Flops and counters. Ii- Transistor as a small signal amplifier, Differential Amplifiers, Operational Amplifiers application, D/A converters and A/d converters.

Phys 423 Plasma Physics: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 224

The objective of this course is to provide a basic text for the students to study plasma physics. The course includes; Nature of Plasma, Plasma Characteristics, Magnetic Configuration and Particle Orbit, Velocity Space Distribution Function and Boltzmann's Equation, Plasma as Magnetohydrodynamic Fluid, Equilibrium, Diffusion of Plasma, Confinement Time, Magnetohydrodynamic Instabilities, Resistive Instability.

Phys 424 Electrodynamics (2): (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 324

This course aims at developing a clear understanding of more advanced Electrodynamics. The course includes: Classical and quantum-mechanical energy loss, Density effect in collision energy loss, Energy loss in electronic plasma, an Elastic scattering of fast particles by atoms, Electrical conductivity of plasma, Radiation emitted during collisions, Relativistic bremsstrahlung, Screening, relativistic radiative energy loss, Method of Virtual Quanta, Radiative Beta Processes.

Phys 425 Mathematical Physics (4) :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 414

This course aims at developing a clear understanding of the basic concepts of Mathematical Physics of Numerical Analysis and Computational Physics, further develop students skill in solving problems. The Numerical Analysis course includes; Roots of an Equation. Numerical Solutions of Simultaneous Equations.interpolation and Approximation. Numerical Differentiation and Integration.And Computational Physics includes; Models and simulation. Finite-difference methods.The Monte Carlo method.The finite-element method.

Phys 426 Waves and Instability in Plasma Physics: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 224

The objective of this course is to provide a basic text for the students to study plasma physics. The course includes: Nature of Plasma, Plasma Characteristics, Equilibrium, Diffusion of Plasma, Confinement Time, Plasma Instabilities, Resistive Instability, Magnetic Configuration and Particle Orbit, Different Velocity Space Distribution Functions, Plasma as Magneto-hydrodynamic Fluid.

Phys 430 Mathematical Physics non-physicist: (2h lecture and 1h tutorial/Weekly)

This course aims at introducing students to some more advanced mathematical physics of Integral Equations and Complex Variables concepts that are used in undergraduate physics courses and to develop further their problems solving skill. The course includes; Integral Equations, Their Origin and Classification, Modeling of Problems as Integral Equations, Volterra Integral Equations. The Green's Function, Fredholm Integral Equations, Existence of the Solutions, Basic fixed Point Theorems, Complex Variables, Analytic Function, Integrals, Series Representation of Analytic Function, Residues and Poles.

Phys 431 Colors Physics: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 221

The course introduces the students to the fundamental of color measurements. The course includes; Electromagnetic radiation in the visible spectrum-physical basis of color specification - spectroradiometer (colorimetric, spectrophotometers) - CIE system of color measurement- Color difference metrology- Color formulation- Color matching formulation.

Phys 432 Optical Instruments: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 221

This course aims to developing the basic concepts of some optical instruments and their applications for a wide variety of physical measurements. The course includes: Microinterferometry, Modern Microinterferometers, Interference microscopes, Spectrophoto-meters, Optical instruments used in medicine.

Phys 435 Scientific Computer Language: (2h lecture and 1h tutorial/Weekly)

This course introducing the concept of programming with Fortran Language and to give practice in the use of the language to solve scientific problems. The course includes: Elements of statements, Mathematical Functions, Arithmetic Assignment Statements, How to write the program Statements? Input and Output Statements, Application for FORTRAN 77, Transfer of control, (Arithmetic and logical IF Statement, Goto), The subscripted variables and dimension, Examples of the Subscript

Notation, The dimension Statement and other information, The DO statement, Explicit uses of DO Loop and Dimension, Read Statement of one data item per line, Read Statement for more than one data item per line, Implied DO List.

Bio-Phys 400 Research Project and Essay in Biophysics: (2h lecture/Weekly**)**

The project of research and report, to develop students to use their scientific knowledge, their ability to plan and execute an extended experimental or theoretical investigation and use all their communication skills to describe their results. To provide an understanding of some techniques of research, including the presentation of results. Students should have obtained an appreciation of research methodologies gained under individual supervision; ability to design and execute a project, write a report and give a talk on it. The student chooses the project in consultation with a member of staff. The subject of the project may be experimental physics or theoretical physics. They should have produced an impressive report on their project, which they can show at career interviews and discuss its content with confidence.

Bio-Phys 401 Practical Bio-Physics (3) :(6h Practical/Weekly)

The Laboratory is designed to illustrate Bio-physical principles and to develop experimental skills; the course includes selected experiments on topics of Physics of Radiotherapy and Electronics Simulation for Biological Systems.

Bio-Phys 402 Practical Bio-Physics (4) :(6h Practical/Weekly)

The Laboratory is designed to illustrate Bio-physical principles and to develop experimental skills; the course includes selected experiments on topics of Radiation Protection and Optical Instruments.

Bio-Phys 410 Experimental Biophysics: (2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the experimental methods Biophysics.The course includes; Separation methods, classification of the techniques, Nuclear magnetic resonance, Mass spectrometry, Dielectric techniques.

Bio-Phys 411 Ultrasonic and Bio-Applications :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Ultrasonic. The course includes; Velocity of sound in fluids, Acoustic intensity and impedance, Decibel scales. Doppler Principles, Ultrasonic generators and receivers, Detection of Ultrasonic Waves, Ultrasonic Imaging.

Bio-Phys 412 Physics of Radiotherapy :(2h lecture and 1h tutorial/Weekly)
Pre-requisite: Bio-Phys 310.

This course aims at developing a clear understanding of the basic concepts of Physics of Radiotherapy. The course includes: The principles of Radiotherapy Physics, Radiation sources, Radiotherapy with single photon beams, Radiotherapy with particle beams, treatment planning, techniques and equipment in teletherapy, dosimetry using small sealed sources and radionuclide sources, radiation protection.

Bio-Phys 413 Physics of Biomaterials and their substitutions: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Bio-Phys311

This course aims at developing a clear understanding of the basic concepts of Physics of Biomaterials and Their substitutions.The course includes; Biological requirements of materials, Crystalline and amorphous phases, Mechanical and Thermal properties of materials, Bone characteristics, Science of Dental Materials, Contact lens properties and interactions, Ceramic implant materials.

Bio-Phys 420 Medical Nuclear Physics: (2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Medical Nuclear physics. The course includes; Production of radionuclides, Gamma cameras, Characteristics of radiopharmaceuticals, Radiation Regulation, Methods of detection and imaging.

Bio-Phys 421 Radiation Protection: (2h lecture and 1h tutorial/Weekly)
This course aims at developing a clear understanding of the basic concepts of Radiation Protection. The course includes; an introduction to radiation protection, Radiation hazards, Radiation intensities and doses, Biological effectiveness, Radiation damage, Radiation shielding.

Bio-Phys 422 Physics of Imaging Medicine: (2h lecture and 1h tutorial/Weekly)
Pre-requisite: Phys 310

This course aims at developing a clear understanding of the basic concepts of imaging processes. The course includes: Imaging concepts, Transforms. Atomic imaging, NMR. MRI. Ultrasonography, Electron microscope, Devices used in medical diagnosis and therapy.

Bio-Phys 423 Computational Biophysics :(2h lecture and 1h tutorial/Weekly)

This course aims at developing a clear understanding of the basic concepts of Computational Biophysics. The course includes; Mathematical Basics, Stochastic processes, Molecular conformation, Population Dynamics, Fourier transform, Action potential.

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Geology Department

First Level:

G101 Physical and Historical Geology :(2h lectures + 3h practical weekly)

Physical Geology: Introduction to the study of the Earth Science and its branches – Theories on the origin of the Universe, the Solar System and the Earth – The atmosphere, the hydrosphere, the lithosphere and the Earth's interior – The Earth's crust – Plate tectonic and the origin of mountains and oceans – Geologic processes shaping the Earth's surface: External processes; Weathering (physical and chemical), wind action and sand dunes, running water (rainfall, rivers and deltas), groundwater and its geologic action, waves and current actions in coastal areas, glacial erosion – Tectonic movements and the internal processes – Structures – Earthquake belts, intensity of earthquake – Volcanicity. Laboratory studies of topographic and geologic maps.

Historical Geology: Introduction to the earth's history, origin of the Earth and its place in the solar system, the most important events (e.g. orogenic, biologic, sedimentation, climatic, etc.) occurred during the geologic history of the earth starting from the Precambrian to the present time. Course syllabus includes also origin of the atmosphere and ocean, origin of life on the earth, orbital forcing and its effect on the earth's climate, Earth's age-dating, and sedimentary environments. Precambrian, Early Paleozoic (Cambrian-Devonian), Late Paleozoic (Carboniferous-Permian), Triassic-Jurassic, Cretaceous, Paleogene-Neogene important events, the Messinian salinity crisis. Quaternary history of mammals and first appearance of man. Extinct fossil groups and vertebrate evolution.

G102 Crystallography and Mineralogy: (2h lectures + 3h practical weekly)

Crystallography: Definition and crystal parts, interfacial angles and their law, crystallographic elements, crystal symmetry, crystal habit and forms, crystal aggregates, crystal systems, holohedral and hemihedral forms, hemimorphism and enantiomorphism, axial ratios-crystal parameters and Miller indices, zone, zone axes and zone symbols and law. General description of the crystal systems. Stereographic projection. Practical examination of models representing crystal forms of seven crystal systems.

Mineralogy: Definitions – Physical and chemical properties of minerals – Chemical compositions – Origin of minerals – Classification of minerals – Minerals of the Earth's crust – Mineral associations in rocks and ore deposits - Description of crystal forms; genesis, field occurrences and uses of some important minerals. Laboratory investigation of hand specimens representing the major mineral groups.

Second Level:

G201 Invertebrate Macropaleontology: (1h lecture + 2h practical weekly)

Invertebrate macropaleontological course includes; Introduction, definitions, zoological nomenclature, how fossils are formed and preserved, explanation of geologic time, how fossils are used in paleoecology and evolution, collecting and preparing fossils, trace fossils, how to identify fossils. Systematic study of invertebrate macrofossil Phyla: Porifera, Cnidaria, Bryozoa, Brachiopoda, Annelida, Mollusca, Echinodermata and Arthropoda.

G202 Igneous Petrology: (2h lectures + 2h practical weekly)

Introduction and definition of common terms used in igneous petrology, Earth's interior, layers and physical properties, abundance and distribution of igneous rocks and their relation to plate tectonics, textures and structures of igneous rocks, nature, origin, source, crystallization of magma. Magmatic differentiation and fractionation, and types of magma chambers. Classification of igneous rocks, description of different igneous rocks and their petrogensis. Practical examination of hand specimens and thin sections representing the different igneous rocks.

G203 Optical Mineralogy: (2h lectures + 2h practical weekly)

The polarizing microscope – preparation of microscopic thin sections in rocks and minerals - Optics of isotropic minerals and their indicatrix – Measuring the refractive index – Optics of anisotropic minerals: Uniaxial, biaxial and their indicatrix – Optical properties of minerals in plane polarized light and between crossed Nicols – Interference colors – Optical orientation and extinction angle – Interference figures . Microscopic examination of thin sections made in selected minerals including description and identification**.**

G204 Structural Geology: (2h lectures + 2h practical weekly)
Pre-requisite: G101

Introduction: Composition of the Earth - Isostasy of the Earth- Forces in the Earth's crust- Different types of structures. Stress: Definition - Types- Uni-axial stress- Plane stress- Stress in 3D - Mohr circle uses in stress analysis - Mohr envelope - Factors controlling the brittle failure of the rocks. Strain: Definition – Types - Strain in 2D - Strain in 3D - Mohr circle uses in the strain analysis - Strain markers analysis. Structural elements, classification, methods of representation. Joints, classification, kinematics of jointing. Faults, definition, classification, kinematics of faulting, criteria of faults recognition, fault mechanics solution. Folds: Definitions - Classifications, Fold mechanisms - Criteria of fold recognitions, superimposed folding. Types of discontinuities and Unconformities. Shear zones and shear sense indicators. Analysis of structural data with geological maps as practicals.

G205 Rock-forming Minerals: (1h lectures + 2h practical weekly)

Definition, classification and atomic structure of silicate rock-forming minerals. Physical and chemical properties of silicate minerals. Their origin, paragenesis, occurrence and industrial uses. Nesosilicates and sorosilicates (olivine group, garnet group, sphene, zircon, Epidote), Insosilicates (single chain pyroxenes, double chain amphiboles), phyllosilicates (mica group, serpentine group, chlorite group), Tectosilicates (silica group, feldspars and feldspathoids). Practical examination of thin sections made in different rocks to recognize the rock-forming minerals.

G206 General Stratigraphy: (2h lectures + 2h practical weekly)

Introduction – Stratigraphic principles and relative geologic time - Stratigraphic contacts - The use of unconformities in dating geologic events – Stratigraphic classifications and nomenclatures- Lithostratigraphic units, Biostratigraphic units, Pedostratigraphic units, Chronostratigraphic units and Geochronologic units. Correlation in stratigraphy; lithocorrelation, biocorrelation, chronocorrelation - Precambrian geography and fossil evidence of early life. Geologic Time Scale (The Phanerozoic Eon). Mass extinctions and the main causes – Magneto-stratigraphy, Seismic-stratigraphy - Cyclic sedimentation and stacking patterns, Sequence stratigraphy without seismic, Sequences, Para-sequences, Systems tracts, Facies tracts, Lowstand, Transgressive and Highstand tracts, Sequence boundaries, Maximum flooding surfaces - Application and examples of sequence stratigraphy on some geologic successions in Egypt.

G207 Petrology: (2h lectures + 2h practical weekly)

Definitions – Rock cycle – Classification of rocks in the Earth's crust – Igneous rocks: magma and magmatic differentiation, various styles of volcanic activity, field occurrence, textures, structures, classification and description of some common igneous rocks. Sedimentary rocks: weathering, erosion, transportation, deposition, classification and description of some common detrital and non-detrital sedimentary rocks. Metamorphic rocks: Metamorphic agents and processes, metamorphic grade and type of metamorphism. Laboratory investigation and description of hand specimens representing different rocks.

G208 Invertebrate Micropaleontology: (1h lecture + 2h practical weekly)

This course is an introductory survey of the major groups of microfossils, including calcareous, siliceous, phosphatic and organic-walled types (foraminifera, ostracods, pteropods, calcareous nannofossils, radiolarians, diatoms, dinoflagellates, conodonts, etc.). The skeletal anatomy, biology, mode of life, and geologic history of these benthic and planktic, marine and nonmarine organisms are to be reviewed. Applications of micropaleontology to biostratigraphy, paleoecology, paleoceanography, paleoclimatology and environmental geology. Major mass extinction events. Practical studies of the different fossil groups under the microscope in terms of morphology and structure.

G209 Sedimentation and Sedimentary Petrology: (2h lectures + 2h practical weekly)

Sedimentation: The origin of sediment grains: Terriginous clastic grains, calcium carbonate grains, evaporites, biogenic silica and phosphates, grain properties. Fluid flow and sediment transport, fluid properties and fluid motion, transport of sediment grains, sediment gravity flows. Bed forms and sedimentary structures: Bed forms and structures in granular sediments, bed forms caused by erosion of cohesive sediment, biogenic and organic–sedimentary structures, soft sediment deformation structures.
Sedimentary Petrology: Introduction - Sedimentary cycle - Classification of sedimentary rocks - Physical properties and textures - Sedimentary structures - Clastic sedimentary rocks: Conglomerates & breccias, sandstones and mud rocks. Non-clastic sedimentary rocks: carbonates, evaporites, chert, phosphorites, coal and iron-rich sedimentary rocks. Genesis and diagenesis of clastic, carbonate and chemical rocks. The practical part includes hand specimen and stained thin-section analysis of different rock types.

G211 Essentials of Geology: (2h lectures + 2h practical weekly +1 tutorial weekly)

Physical Geology: Introduction to the study of the Earth Science and its branches – Theories on the origin of the Universe, the Solar System and the Earth – The atmosphere, the hydrosphere, the lithosphere and the Earth's interior – The Earth's crust – Plate tectonic and the origin of mountains and oceans – Geologic processes shaping the Earth's surface: External processes; Weathering (physical and chemical), wind action and sand dunes, running water (rainfall, rivers and deltas), groundwater and its geologic action, waves and current actions in coastal areas, glacial erosion – Tectonic movements and the internal processes – Structures – Earthquake belts, intensity of earthquake – Volcanicity. Geologic Time Scale and the earth's history (Precambrian - Paleozoic - Mesozoic – Cenozoic) - Quaternary history of mammals and first appearance of man. Extinct fossil groups and vertebrate evolution.
Mineralogy & Petrology: Origin and classification of minerals – Physical and chemical properties of minerals – Mineral associations in rocks and ore deposits - Description of crystal forms; genesis, field occurrences and uses of some important minerals. Rock cycle – Classification of rocks in the Earth's crust – Igneous rocks --Sedimentary rocks -- Metamorphic rocks. Laboratory investigation of hand specimens representing the major mineral groups and different rocks. Training on using topographic and geologic maps.

GPhys 201 Introduction to Geophysics (1): (2h lectures + 2h practical weekly)

Introduction, definition and branches of geophysics. Gravity field of the Earth. Geoid, GPS and isostasy. Seismic methods and earthquakes. Magnetic and paleomagnetic methods. Electric and geothermal methods. Borehole geophysics. Practical work of some measured geophysical parameters.

GPhys 202: Introduction to Geophysics (2): (2 lectures + 1 tutorial weekly)

General introduction to wave phenomena:Hygens, Principle, Fermat's Principle, Snell's law, Boundary Conditions, Diving waves, *etc*. Physical properties of rocks, Elastic characteristics of solids, Types of seismic waves, Types of seismic waves propagation characteristics of P- & S-waves, .Attenuation, Absorption and Polarization of seismic waves in earth materials, Reflection, refraction, and diffraction of elastic waves. Velocities of seismic waves in rocks.

GPhys 204 Electric Prospecting: (2 lectures + 1 tutorial weekly)

Basic physics of electric current flow-electric resistivity of pure elements and compounds- electric resistivity of multiphase materials- electric current flow in half space- potential of two current electrodes; definition of apparent resistivity-current flow in uniform earth with two electrodes- electric methods and their applications: DC resistivity method SP method, and IP method.

GPhys 206 Gravity Prospecting: (2 lectures + 1 practical weekly)

Introduction to gravity methods. Basic concepts of gravity methods, gravitational force, the Earth's mass and density, gravitational potential, the normal spheroid and Geoid, units of gravitational acceleration, densities of rocks. Measurement of gravity, absolute measurements; pendulum & free falling, relative measurements; stable & unstable gravity meters. Type of corrections, free-air, Bouguer, topographic, latitude, tides, air pressure, isostatic, E̊tov̊os, and instrumental drift.

Interpretation of gravity data, ambiguity of gravity, regional and residual anomaly separation and filtering techniques, frequency domain filtering. Calculating of the gravity anomalies of simple shape bodies, depth estimation methods (forward and inverse modeling). Applications of gravity and some case studies of gravity measurements.

GPhys 208 Magnetic Prospecting: (2 lectures + 1 tutorial weekly)

Physical basis, magnetic properties of natural minerals, magnetization of rocks, magnetism of the Earth, geomagnetic field instruments, magnetic field survey, correction of the magnetometer variations, qualitative and quantitative interpretation of magnetic data, applications and case studies.

Third Level:

G301 Metamorphic Petrology: (2h lectures + 2h practical weekly)
Pre-requisite: G202

Definition, metamorphism, limits and type of metamorphic agents, metamorphic processes, mineral assemblages and textures of metamorphic rocks, metamorphic grade and facies, metapelites, metabasites, metacarbonates and calc-silicates, metaultramafics, ores associated with metamorphic rocks, Examples of metamorphic rocks in Egypt. Practical examination of different types of metamorphic rocks.

G302 Field Geology and Geologic Surveying:(1h lecture + 2h practical + 1h tutorial weekly)
Pre-requisite: G204

Introduction and plate tectonics, ordering of geologic events. Stratigraphy, correlation and lithofacies maps. Field equipments in geologic mapping. Mapping igneous rocks, mapping sedimentary rocks. Geologic cross-sections and map interpretation, applied geologic problems.

G303 Depositional Environments and Facies: (2h lectures + 2h practical weekly)
Pre-requisite: G205

Continental environments and facies analysis. Deserts, alluvial fans, river plains, lakes, glacial environments. Facies belts. Coastal and shelf environments: Physical processes, Delta estuaries, Linear clastic shorelines, clastic shelves. Carbonate–evaporite shorelines, shelves and basins. Oceanic environments, oceanic processes, clastic oceanic environments, pelagic oceanic environments. Standard microfacies types.

G304 Vertebrate Paleontology: (1h lectures + 2h practical weekly)
Pre-requisite: G201

Definitions; Subphylum: Vertebrata contains Superclass: Pisces and Superclass: Tetrapoda (Amphibia, Reptila, Aves and Mammalia). Dinosaur paleobiology and the origin of birds. Major mammalian lineages and Primate origins. Importance of Fayoum province in Egypt as a famous locality for vertebrate fossils. Wadi El-Hitan as a world heritage protectorate in Egypt. Also the study includes examples of each class in the laboratory.

G305 Hydrogeology and Geomorphology: (2h lectures + 2h practical weekly)
Pre-requisite: G101

Hydrogeology: Hydrologic cycle and quantifying hydrologic budget. Runoff and stream flow, properties of aquifers, unsaturated flow and recharge. Aquifer characteristics. Principal of groundwater flow. Steady state flow, unsteady radial flow. Non-equilibrium flow. Slug test. Aquifer characterization using field data. Straight line graphical method, non-equilibrium type curve fits. Hydrologic boundaries, geologic terrains. Water chemistry and water quality. Groundwater pollution - Contaminant transport.
Geomorphology: Relation with other subjects - Geomorphic processes - Some fundamental concepts - Tools of geomorphologists - Relief of the Earth - Geomorphic agents and processes - Weathering (physical, chemical and biotic weathering). Geomorphic significance of weathering - Mass wasting and gravity transfer processes - Topography produced by streams in humid regions (running water)- Topography produced by wind in arid regions - Topography produced by waves and currents (coastal landforms). Karsts topography - Ground water geomorphologic features.

G306 Mining and Quarrying Geology: (2h lectures + 1 tutorial weekly)
Pre-requisite: G102

The main focus will be on methods and equipment used for the exploitation of all types of solid mineral resources both open pit and underground. The course will also encompass pre-production and post-production activities related to mining and quarrying geology projects. This course covers the basic concepts of mining, quarrying and mineral processing: how mines are found, how they are built, how the ore is processed, how the waste is disposed, how mineral products are marketed, and some ideas about where mining will be in the future. Parts of the course require some basic numeracy and high school science. However all of the material is taught in a friendly, non-threatening manner and is quite easily understood by someone who likes to watch Nova or the Discovery Channel. Additional topics will be economy, OHS (occupational health and safety), quality assurance and public rules and regulations. Software for production planning and techniques for production optimization will be presented.

G307 Geotectonics: (2h lectures + 2h practical weekly)
Pre-requisite: G204

Plate tectonic theory: Definition, plate boundaries, continental drifts, convergent plate boundaries, divergent plate boundaries, transform plate boundaries, plate tectonics and petroleum accumulation, plate tectonics and magma activity. Extensional structural setting: Extensional gashes and its analysis, boudinage structures and its analysis. Normal, gravity and listric faults Pull-apart tectonic setting, analysis of extensional and trans-tensional structures. Examples of extensional domains and its structural analysis. Extensional tectonics and related magmatism. Compressional structural setting: Thrust tectonics, thrust nappe geometry, tectonic analysis of compressional-transpressional domains. Examples of compressional tectonic domains. Compressional tectonics related magmatism. Wrench system: Examples of wrench systems, analysis of wrench system and wrench system-related magmatism.

G308 Economic Geology: (2h lectures + 2h practical weekly)
Pre-requisite: G102

Definition of mineral deposits, ore, grade of ore, ore mineral utility and strategic mineral deposits, exhaustion of mineral deposits, economic evaluation of mineral deposits, metallogenic provinces, metallogenic epoch. Genetic classification of mineral deposits, plate tectonic theory and formation of ore deposits. Endogenic deposits, magmatic mineral deposits, hydrothermal mineral deposits, pneumatolytic mineral deposits, metamorphic mineral deposits, sedimentary mineral deposits. Tectonic history of Egypt, Precambrian mineral deposits in Egypt, Phanerozoic mineral deposits in Egypt. Ornamental, building and industrial stones. Gemstones. Examples of some Egyptian economic mineral deposits.

G309 Geochemistry: (2h lectures + 2h practical weekly)
Pre-requisite: G102

Structure and composition of the Earth's Interior, primary geochemical differentiation of the Earth, geochemical classification of elements, crystal chemistry, atomic substitutions, geochemistry of igneous rocks, geochemical environment, sedimentation and geochemistry of sedimentary rocks, chemical alteration and physical parameters controlling the alteration, metamorphism and geochemistry of metamorphic rocks, the geochemical cycle, chemical composition of meteorites. Uses of stable isotope geochemistry. Practical calculation of the Niggli's Values and CIPW-normative minerals to identify the igneous rocks.

G310 Subsurface Geology (1h lectures + 2h practical weekly)
Pre-requisite: G205

Definition, application of subsurface geology, pure scientific value, prospecting and exploration of economic importance. Construction purposes. Information needed for subsurface evaluation. Sources of subsurface geological data. Methods for subsurface geology. Drilling (structural, stratigraphic and drilling for other purposes). Geophysical methods. Geochemical methods. Factors affecting geochemical subsurface interpretation. Correlation (local and regional). Main methods of correlation: lithologic correlation, paleontologic correlation and geochronologic correlation. Facies, nature of facies, facies analysis. Subsurface maps.

G311 Mineral Exploration: (1h lectures + 2h practical weekly)

Pre-requisite: G102

Provides an introduction to the methods and techniques that are used in prospecting and exploring for mineral deposits. The course will cover reading and interpreting topographic and geological maps, online claim staking, measuring the strike and dip of geological structures, prospecting techniques and an overview of geological, geochemical and geophysical methods used in mineral exploration including drilling. It will also discuss aspects of marketing and optioning mineral properties. Laboratory/field exercises include using a compass and GPS, measuring strike and dip, laying out a grid, researching a prospecting play through the use of BC provincial government websites such as MapPlace and Minfile and the design of a simple prospecting/exploration program. Completion of MINE 1001 or MINE 1003 or a basic course in geology is strongly recommended before taking this course.

G312 Petroleum Geology: (2h lectures + 1h tutorial weekly)
Pre-requisite: G205

Introduction and definitions. Exploration methods for hydrocarbon: surface occurrences (direct indication); seepages, springs and exuding bitumen. Mud volcanoes and mud flow. Bitumen impregnated sediments. Vug and cavity fillings. Kerogen shale and oil shale. Origin of petroleum: organic theory of origin of petroleum and its evidences. Conditions of hydrocarbon genesis – functions of bacteria in oil formation. Migration of oil and gas: Primary and secondary migrations. Evidences in support of oil migration. Accumulation of oil (oil traps): structural traps: fold, faults and fissures; Stratigraphic traps: (reefs, sand lenses and facies change); Secondary traps: due to ground water activity; Secondary traps due to unconformity, truncation and sealing; and Combination traps.

G313 Mineral Analysis: (2h lectures + 1h tutorial weekly)
Pre-requisite: G209

Introduction, X-ray diffraction (XRD), X-ray fluorescence (XRF), atomic absorption spectroscopy (AAS), differential thermal analyses (DTA), inductively coupled plasma spectroscopy (ICP), scanning electron microscopy (SEM), and Cathodoluminscence microscopy (CL), stable isotopes analyses and staining, and electron microprobe analyses (EMP) techniques. Practical course includes identifications of clay and other minerals using XRD, EMP and DTA.

G314 Engineering Geology: (2h lectures + 1h tutorial weekly)
Pre-requisite: G101

Introduction – Classification of rocks – Physical properties of rocks – Construction, ornamental and pavement rocks – Mechanical properties of rocks: Deformation of rocks (uniaxial, biaxial and triaxial stresses) – Stress-strain curves. Geologic structures: Faults, mechanism and recognition – Folds, mechanism, classification and recognition – Engineering importance of joints, faults and folds – Soil mechanics (physical and chemical weathering) – Soil formation and characters of the soil profile – groundwater problems – Earthquakes – Landslides - Engineering problems associated with soils (foundations and tunnels) – Geology of dams and reservoir sites.

G315 Geostatistics (2h lectures + 1h tutorial weekly)

Overview (Basic statistics) - Probability Theory Review - Spatial Statistics-Random variables and random functions - Models of spatial variability – Kriging – Cokriging -Indicator methods - Geostatistical risk mapping.Calculation of experimental variograms, directional analysis (Rose Diagram and variogram modeling. Mathematical and statistical principles behind Kriging, Co-kriging and stochastic simulations. Geostatistical methods in spatial interpolation based on a set of 2D sampled data. Integration of the various components of a geostatistical analysis

G316 Marine Geology: (2h lectures + 1 tutorial weekly)

Introduction and aim of the course. Ocean floor morphology and plate tectonics. Ocean water circulation and its driving force. Physical and chemical properties of ocean water, geochemical cycling in the water column and in the oceanic crust. Ocean sediments and their environments of deposition and diagenesis after burial. Importance of microfossils, stratigraphy and isotopes in paleoclimatology and paleoceanography of the ocean. Laboratory works include the description and application of the modern instrumental methods used for analysing ocean waters and sediments, coring and determination of ocean floor bathymetry.

G317 Hydrogeology and Geomorphology (1): (2h lectures + 2 practical weekly)
Pre-requisite: G210

Hydrogeology: Hydrologic cycle and quantifying hydrologic budget. Runoff and stream flow, properties of aquifers, unsaturated flow and recharge. Aquifer characteristics. Principal of groundwater flow. Steady state flow, unsteady radial flow. Non-equilibrium flow. Slug test. Aquifer characterization using field data. Straight line graphical method, non-equilibrium type curve fits. Hydrologic boundaries, geologic terrains. Water chemistry and water quality. Groundwater pollution - Contaminant transport.
Geomorphology: Relation with other subjects - Geomorphic processes - Some fundamental concepts - Tools of geomorphologists - Relief of the Earth - Geomorphic agents and processes - Weathering (physical, chemical and biotic weathering). Geomorphic significance of weathering - Mass wasting and gravity transfer processes - Topography produced by streams in humid regions (running water)- Topography produced by wind in arid regions - Topography produced by waves and currents (coastal landforms). Karsts topography - Ground water geomorphologic features.

GPhys 301 General Geophysics: (2h lectures + 2h practical weekly)

Introduction, definition and branches of geophysics. Gravity field of the Earth. Geoid's, GPS and isostasy. Seismic methods and earthquakes. Magnetic and paleomagnetic methods. Electric and geothermal methods. Borehole geophysics. Practical work of some measured geophysical parameters.

GPhys 302 Introduction to Well-Logging: (2h lectures + 3h practical weekly)

Introduction to borehole geophysics. Borehole environment and basis of recording logs. Quick review of electrical properties of rocks, theories and uses of electrical logs. Review of radioactive properties of rocks, theories and applications of radioactive logs. Review of acoustic properties of rocks and theory and applications of sonic logs. Thermal properties of rocks, theory and applications of thermal logs. Other types of wire line logs. Combination and quick look interpretation of the different types of wire line logs. Application of well logging in different fields.

GPhys 303 Seismic Prospecting-1: (2h lectures + 2h practical/ weekly)
Pre-requisite: GPhys201

Seismic waves, Body waves & Surface waves. Propagation of Seismic waves: Huygens' Principle, Fermat's Principle, Reciprocity Principle, Snell's Law, Diving waves, Ground roll, Boundary discontinuity, Conversion, Acoustic Impedances, Reflection & transmission coefficients at normal incidence, Factors affecting the amplitude of seismic wave . Seismic instruments (Recording systems, Seismic sources), Refraction Seismic (Basic formulae, Travel time curve data and interpretation techniques), Problems of shallow refraction seismic method: Undetected layers (Velocity inversion, hidden layer), and ambiguities, Field arrays of geophones. Static Corrections, Down-hole (up-hole) seismic survey, Vertical Seismic Profiling VSP.

GPhys 304 Seismic Prospecting-2: (2h lectures + 2h practical/ weekly)
Pre-requisite: GPhys201

Basic reflection theory, geometry of reflected ray paths Ray tracing technique and synthetic seismogram. Seismic noises and multiples. Seismic velocity, Factors affecting on it, Types of seismic velocities. Normal Move out (NMO) and Dip Move out (DMO). Conventional spreads for reflection seismic, Common Depth Point Technique (Reflection Profiling), Common Mid-Point (CMP), Sorting & Stacking. Seismic attributes. Gather types. Muting. Fold coverage. Migration. Filtration. Deconvolution. Aliasing. 2D seismic interpretation. 3D seismic overview.

GPhys 305 Geothermal Prospecting: (2h lectures + 1h tutorial weekly)
Pre-requisite: **Gphy201**

Thermal properties of rocks. Terrestrial heat flow and heat flow measurements and global heat flow data. Heat flow, age and region of anomalous heat flow. Heat production and transfer in the Earth and temperature within the Earth. Thermal prospecting methods and measuring techniques. Examples of geothermal surveys. Geophysical methods and geothermal exploration. Geothermal activities in Egypt and some case studies.

GPhys 306 Radiometric Prospecting: (1h lectures + 2h practical weekly)
Pre-requisite: Gphy201

Introduction to radiometric and applications of radiometric. Fundamentals of natural radioactivity, radioactivity in nature, types of radiations, cosmic rays, decay series, half-life period, equilibrium, scattering of Gamma Rays, energy spectra, units. Radiation effects on rocks and minerals, interaction of gamma rays with matter. Uranium and Thorium minerals, behavior of U and Th during magmatic crystallization and their geochemistry. Classification of radioactive minerals, U and Th radioactive minerals. Instrumentation and calibration, types of detectors, Giger Muller, Scintllometers and spectrometers and radon detector. Field surveys and data corrections, ground and airborne surveys, dead time correction, background corrections and statistical noise correction. Interpretation of radiometric, qualitative and quantitative etc… Applications and some case studies of radiometric measurements.

GPhys 307 Electromagnetic Prospecting: (2h lectures + 2h practical weekly)
Pre-requisite: GPhys201

The basic EM theory: Maxwell and constitutive equations, Electromagnetic diffusion equations, Cagniard impedance- Frequency domain electromagnetic methods: Magnetotelluric method, Ground penetrating Radar, VLF and HLEM methods- Time domain electromagnetic methods- Applications of electric and electromagnetic methods- Practical exercises for all electromagnetic methods.

Fourth Level:

G400 Research Project and Essay in Geology: (2h lecture weekly for 1 term)

Reviewing a research project in geology to be selected by the Department, preparing a written essay on it (continuous in the two terms).

G401 Hydrogeology and Geomorphology of Egypt: (2h lectures + 2h practical weekly)
Pre-requisite: G204

Introduction. Major hydrogeological and geomorphological sectors of Egypt: the northwestern coastal zone, the Nile Valley, the Nile Delta and its fringes, the Western Desert, the Eastern Desert and the Sinai Peninsula. Hydrogeological and geomorphological setting on the northwestern coastal zone. Hydrogeology and geomorphology of the Nile Valley. Hydrogeology and geomorphology of the Nile Delta. Comparison study between east and west Nile Delta. Hydrogeology and geomorphology of the Western Desert. Comparison study between some pilot areas in the north and south Western Desert. Hydrogeology and geomorphology of the Eastern Desert and Red Sea. Hydrogeology and geomorphology of the northern Sinai. Hydrogeology and geomorphology of the southern Sinai. The study includes location, general geology, hydrogeology, hydrology, hydrochemistry and geomorphology of each sector.

G402 Radioactive Geology: (2h lectures + 1h tutorial weekly)
Pre-requisite: G306

Methods of formation of mineral deposits, genetic classification of mineral deposits, plate tectonic theory and formation of mineral deposits. Definitions, radioactive elements and radioactive series, effects of radiations on minerals and rocks and their significance, geochemical properties and abundances of U and Th in rocks and minerals, geochemical cycles of U and Th in nature, nuclear elements and their uses. Classification of U and Th minerals with examples, radioactive mineral deposits in Egypt with examples.

G403 Geology of Deltas: (2h lectures +1h tutorial weekly)
Pre-requisite: G205

The situation of deltas within the river systems (drainage basin, alluvial valley, delta, and receiving basin) - Effects of hydrodynamic regime sediment load and geologic structure on the morphology of deltas - The impact of climatic regimes in the drainage basin and delta region on the types and sedimentary sequence of deltas - Effects of river mouth processes (Inertia, friction and buoyancy) on the geometry of the main delta sand body (delta front) - The control of subaqueous delta morphology by the properties of receiving basin (wind, waves, tides, shelf slope and coastal currents) - The

morphology and sediments of the different Nile Delta sub environments - The subsurface sequence, geologic and oil potentiality of the Nile Delta - The environmental problems of the modern Nile Delta caused by deficiency of discharge after the construction of High Dam, the subsidence of delta and sea level rise due to the green-house effect, and the proposed solutions to overcome these problems.

G404 Geologic Field Training: (3h practical and 3h tutorial weekly)

Exercises describing geologic maps of selected areas in Egypt – Week-long field trip to a selected desert area in the Sinai, Red Sea mountains, Western Desert or the Nile Valley – One-two days field excursion to the nearby localities e.g. the northern coastal plain, Greater Cairo area (Mokattam, Abu Roash, Cairo-Suez, Qattamiya-Ain El Sukhna, Cairo Geological Museum), Gabal Shabraweet, Gabal Ataqa and Fayoum Province – Field studies include recognition of rock types, stratigraphic units, dominant structures, collecting rock and fossil samples – Laboratory studies include description of the collected minerals, rocks and fossils.

G405 Paleobotany and Palynology: (2h lectures + 2h practical weekly)
Pre-requisite: G208

Paleobotany & Palynology focus on studying plant megafossils and organic microfossils (e.g. Spores & Pollen) with emphasis on**:** Definition of the subject- Aims and applications- Types of plant preservation- Methods used for the examination of fossil plants- System of nomenclature and classification of fossil plants- Divisions of the plant kingdom- History of the plants in the Palaeozoic, Mesozoic and Cenozoic worldwide and in Egypt- Fossil flora and Palaeoclimatology- Relationship of palynomorphs to sedimentation- Applied palynology. Practical sessions focus on the study of plant megafossils worldwide and those found in Egyptian strata from Carboniferous- Neogene.

G406 Sedimentary Basins: (2h lectures + 2h practical weekly)
Pre-requisite: G204

Students will learn about different basin types, their classification, formation mechanisms such as lithospheric stretching, flexure, and basins associated with strike-slip deformation. The development of basins in space and time, and their subsidence and thermal history, and weathering will be discussed. Basin stratigraphy and petroleum system are end members of studying basin analysis.
Course contents: Introduction - Basin Classifications -Troughs, Rifts, Aulcogens, and Divergent Continental Margins - Cratonic, Continental, and Epicontinental Basins- Oceanic Basins- Basins Associated with Active Margins and Folded Belts -The Sediment Routing System- Basin Stratigraphy- Subsidence and Thermal History- The Petroleum Plays.

G407 Basement Rocks of Egypt: (2h lectures + 2h practical weekly)
Pre-requisite: G207

Historical review, classification of the basement complex in Egypt, stratigraphic and tectonic units, metallogenesis, application of plate tectonic theory, history of magmatic activities, tectonic evolution, detailed description of the rock units of the basement complex: e.g. metamorphic rocks, sedimentation and sedimentary rocks, volcanicity and volcanic rocks, ophiolitic rocks, gabbroic rocks, and granitoid rocks. Practical examination of hand specimens and thin sections representing the different basement rock units in Egypt.

G408 Geotectonic and Tectonics of Egypt: (2h lectures + 2h practical weekly)
Pre-requisite: G204

Plate tectonic theory: continental drifts, convergent plate boundaries, divergent plate boundaries, transform plate boundaries, plate tectonics and petroleum accumulation, plate tectonics and magma activity. Examples of extensional domains and its structural analysis. Extensional tectonics and related magmatism. Compressional structural setting: Thrust tectonics, thrust nappe geometry, tectonic analysis of compressional-transpressional domains. Examples of compressional tectonic domains. Compressional tectonics related magmatism. Wrench system: Examples of wrench systems, analysis of wrench system and wrench system-related magmatism.

Pan African Orogeny. Proterozoic plate tectonism in the Afro-Arabian Shield. Wilson's cycle and magma activity. Basement rock units. Major structural elements affecting the Pan-African Orogenic belts: Sutures, thrust, and shear zones. Magmato-tectonic evolution of the Afro-Arabian Shield in the

Eastern Desert of Egypt. Precambrian structures and its role in the configuration of the Paleozoic sedimentary basins. Paleozoic tectonism and related structures. Mesozoic tectonsim and related structures. Reactivation of early formed structures and neotectonics. Practical examination of some structural and tectonic maps of selected areas in Egypt.

G409 Stratigraphic Geology of Egypt: (2h lectures + 2h practical weekly)
Pre-requisite: G206

Introduction; Paleozoic outcrops in the Gulf of Suez region, subsurface of the Western Desert and exposures at Oweinat area. Triassic exposures in Araif El Naqa. Jurassic of Gabal Maghara, Gulf of Suez and subsurface of north Western Desert. Cretaceous rock stratigraphy and their economic importance. Paleogene rock stratigraphy in the Nile Valley & Fayoum. Neogene deposits in the Red Sea facies, Western Desert and the subsurface of the Nile Delta. Quaternary deposits in Egypt. Practical studies including stratigraphic correlation charts, geologic maps, and some index fossils.

G410 Petroleum Geology of Egypt: (2h lectures + 2h practical weekly)
Pre-requisite: G206

Definition of oil and /or gas pool. Field and province. Petroliferous provinces in Egypt. The Gulf of Suez petroliferous province: Geologic setting, stratigraphy, petroleum geology. Some examples of oil fields. The Nile Delta petroliferous province: Geologic setting, stratigraphy, petroleum geology. Abu Madi gas field. The Western Desert petroliferous province: Geologic setting, stratigraphy, petroleum geology and sedimentary basins. Razzak oil field. Northern Sinai petroliferous province.

G411 Environmental Geology and Geoarcheology: (2h lectures + 2h practical weekly)
Pre-requisite: G101

Environmental Geology: Introduction – Atmosphere – Lithosphere – Hydrosphere – Biosphere – Environment and human activities – Global warming and sea level rise – Greenhouse effect – Coastal erosion – Shoreline protection – Pollution in urban areas due to industrial and mining activities – Groundwater pollution due to extensive use of fertilizers and insecticides – Water-logging problems – Sand dune migration – Environmental Impact Assessment – Examples from Egypt and other countries.
Geo-archeology: Introduction - Principles and techniques – Pre-historic man (Paleolithic and Neolithic) implements - Water logged sites – tailoring GIS software for archeological application – Application of Palynology to Archeology - Geophysical and geochemical analyses of archeological sites – Faunal and floral assemblages in Holocene sediments – Settlement sites – Evidence of agriculture – Economic utility of archeological sites – Case studies from the Nile Delta, Pyramids Plateau and Upper Egypt.

G412 Paleoecology and Paleoclimatology: (2h lectures +1h tutorial **weekly**))
Pre-requisite: G201

Paleoecology: Introduction, Paleoeclogical data derived from sedimentology, mineralogy, geochemistry, and paleontology as concepts from all these fields are applied to the study of ancient organisms and their environments.
Paleoclimatology: Introduction - Environmental parameters- Taphonomy - Populations in palaeoecology – Palaeobiogeography – Climate - The Ice Ages - Global warming and sea-level Rise - Aspects of Palaeozoic – Cenozoic global climate - Palaeoclimatic data from fauna and flora.

G413 Remote Sensing and GIS: (2h lectures + 2h practical weekly)
Pre-requisite: G101

Remote sensing: Introduction, spectral signatures, aerial photography, satellite radar and GPS, digital remote sensing, image processing, principal components transformation, digital filters, geometrical aspects and mapping of RS, unsupervised classification, supervised classification, atmospheric correction and spectral signatures and applications.
Geographic Information System: GIS basics, raster and vector GIS data, spatial data preparation and assigning GIS themes, GIS project planning and design. Data digitizing, editing, and geocoding. Identifying digitizing errors, correcting, spatial data using ARCEDIT, constructing topology, getting

attribute data into ARC/INFO, linking attributes to spatial features, georeferencing and coordinate systems, joining adjacent themes, spatial data Analysis and GIS Queries.

G414 Petroleum Geochemistry (2h lecture + 1h tutorial weekly)
Pre-requisite: G314

Introduction - Carbon, the Earth and life - Chemical composition of organic matter -Production, preservation and degradation of organic matter -The thermal alteration of kerogen and the formation of oil - Applications of organic geochemical research for hydrocarbon exploration.

G415 Environmental Geology: (2h lectures + 2h practical weekly)
Pre-requisite: G210

Earth Environments (Atmosphere – Lithosphere – Hydrosphere – Biosphere) – Causes of Environmental problems - Natural Hazards due to geologic processes - Flush floods - Sand dune migration – Coastal erosion and shoreline protection – Human Impacts on the Environments - Human inputs and urbanization outputs – Global warming and sea level rise — Pollution in urban areas due to industrial and mining activities – Groundwater pollution due to extensive use of fertilizers and insecticides – Water-logging problems – Environmental Impact Assessment – Key of sustainable developments -- Fossil fuels and renewable energy resources - Environmental problems; Examples from Egypt and other countries.

GPhys 400 Research Project and Essay: (2h lecture weekly for one term)

Reviewing a research project in geophysics to be selected by the Department, preparing a written essay on it.

GPhys 401 Well-Logging: (2h lecture + 2h practical weekly)
Pre-requisite: GPhys 201

Introduction to borehole geophysics. Borehole environment and basis of recording logs. Quick review of electrical properties of rocks, theories and uses of electrical logs. Review of radioactive properties of rocks, theories and applications of radioactive logs. Review of acoustic properties of rocks and theory and applications of sonic logs. Thermal properties of rocks, theory and applications of thermal logs. Other types of wire line logs. Combination and quick look interpretation of the different types of wire line logs. Application of well logging in different fields.

GPhys 402 Reservoir Petrophysics: (2h lectures + 2h practical weekly
Pre-requisite: GPhys 201

Overview of reservoir rocks, Rock porosity: Definition - Classification - Range of values of porosity- Factors affecting porosity- Measurement of porosity - Subsurface measurement of porosity- Compressibility of porous rocks, Capillary pressure, Fluid saturation, Multiphase flow in porous rock: Description of Permeability, Diagenesis of reservoir rocks, well logging analysis and how can be used for determining petrophysical characteristics, Formation evaluation: Hydrocarbon potentialities of reservoir, Practical exercise for determining the petrophysical parameters of reservoir rocks.

GPhys 403: Earthquakes and Earthquake Engineering: (2h lectures + 2h practical weekly)
Pre-requisite: GPhys 201

Earthquakes: definitions, causes & distribution of earthquakes. Seismic waves. Seismographs and seismological observatories. Travel times (tables & curves). Seismograms interpretations. Earthquakes and the Earth's interior. Seismotectonics: Plate boundaries, interplate and intraplate earthquakes. The earthquake cycle. Earthquake prediction. Strong motion seismology. Earthquake effects. Seismic risk. Tsunamis.

GPhys404 Geophysical and Geological Field Training: (4h practical and 2 tutorial weekly)

Exercises describing geologic, magnetic, gravity maps and seismic profiles of selected areas in Egypt. Week-long field trip to a selected desert area in the Sinai, Red Sea mountains, Western Desert or the Nile Valley. One-two days field excursion to the nearby localities e.g. Helwan observatory, some oil-drilling companies working on the Delta plain, the northern coastal plain, Greater Cairo area (Mokattam, Abu Roash, Cairo-Suez, Qattamiya-Ain El Sukhna, Cairo Geological Museum), Gabal Shabraweet, Gabal Ataqa and Fayoum Province. Field studies include recognition of rock types, stratigraphic units, dominant structures, training on some geophysical equipment – Laboratory studies include interpretation and processing of the measured geophysical data using computer software**.**

GPhys405 Paleomagnetism: (2h lectures + 2h practical weekly)
Pre-requisite: GPhys201

Physical basis, fundamentals of rock and mineral magnetism, common magnetic minerals and their identification, studying climatic changes through magnetic properties of sediments and soils, sampling and measurements, statistical analysis, geomagnetic applications, reversals of magnetization, geological applications.

GPhys 406 Environmental Geophysics and Geoarcheology: (2h/W + 2h practical weekly)
Pre-requisite: GPhys201

Environmental Geophysics: Introduction. Application of geophysical methods such as resistivity, electromagnetic, and ground penetrating radar to investigate geological, geotechnical, hydrological and environmental problems. Physical properties of earth materials as they relate to geophysical exploration and environmental geosciences. Overview of small-scale high resolution applications of other geophysical methods (seismic, gravity, magnetic) .
Geo-archeology: Introduction - Principles and techniques – Pre-historic man (Paleolithic and Neolithic) implements - Water logged sites – tailoring GIS software for archeological application – Application of Palynology to Archeology - Geophysical and geochemical analyses of archeological sites – Faunal and floral assemblages in Holocene sediments – Settlement sites – Evidence of agriculture – Economic utility of archeological sites – Case studies from the Nile Delta, Pyramids Plateau and Upper Egypt.

GPhys408 Geophysical Data Analysis: (2h lectures + 2h practical weekly)
Pre-requisite: GPhys201

Introduction- Inverse problem in geophysics- Describing and formulating inverse problem-Solving over determined linear inverse problem- Constrained linear least squares inversion- Error analysis in linear inversion- Solving Non-Linear Inverse Problems- Non-Linear Biased Estimation- Solution Appraisal in Non-Linear Inversion-Sample Specialized Applications of Inverse Theory.

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Chemistry Department

First Level

Chem 101 Principles of Inorganic, Organic and Biochemistry: (2h lectures + 3h practical weekly)

Inorganic Chemistry: (12 lecture x 1 hr)
Chemical calculations. Atomic spectra (Electromagnetic waves, Bohr's theory, principles of wave mechanics). Atomic structure. Electronic configuration of atoms. Periodic Table and the general properties of representative elements (size of atoms and ions, ionization energy, electronic affinity, electronegativity, electropositivity and polarization).Oxidation states. Types of chemical bonds (ionic, covalent, coordinate, hydrogen and metallic). Lewis structure and formal charge.Theories of bonding: valance shell electron pair repulsion (VSEPR), valence bond theory(VBT), molecular orbital theory (MOT) and molecular geometry.
Organic Chemistry: (9 lecture x 1 hr) Covalent Bonds of carbon – Atomic Orbitals - Molecular Orbitals - Hybirdization- Molecular Geometry - Polar Covalent Bonds - Polar and Nonpolar Molecules – Drawing Organic compounds (molecular formulae – structural formulae - displayed formulae 3-dimentional formulae - Skeletal formulae) - Functional Groups – Structure, Nomenclature and Representative Examples of: alkanes, alkenes, alkynes, and Aromatic Compounds, Alkyl Halides, Alcohols, Ethers, Amines, Aldehydes and Ketones, Carboxylic acids and Carboxylic acid derivatives.
Biochemistry: (3 lecture x 1 hr) Chemistry of carbohydrates, lipids and amino acids: Nomenclature, Classes: – Chemical Reactions – Clinical importance of Carbohydrates; Fatty acids- Lipoproteins – Membrane structure – Functions; Structure of amino acids - Reactions of amino acids - Peptides – Protein Structures - Globular and Fibrous Proteins – Protein folding.
Practical: Inorganic lab work (3 hours lab x 5 weeks), Identification of simple Organic compounds (3 hours lab x 5 weeks).

Chem 102 Principles of Physical and Analytical Chemistry :(2h lectures + 3h practical weekly)

Physical Chemistry: (12 lecture x 1 hr) Significant figures, Measurement and unit: The gaseous state, the gas laws, real and ideal gases, the liquid state and the solid state. Thermochemistry, thermo- chemical equations, Hess's law; ΔH for various processes; bond energies, variation of ΔH with temperature; heat capacities:. Kirchoff's equation. The Solution Process, Ways of Expressing Concentration. Factors Affecting Solubility. Raoult's Law Colligative Properties - Lowering the Vapor Pressure - Boiling-Point Elevation - Freezing Point Depression – Osmosis -Determination of Molar Mass. Chemical equilibria: The equilibrium state. The Reaction Quotient – The relationship between K_c and K_p - Heterogeneous Equilibria - Le-Chatelier's Principle and Chemical Equilibrium. Equilibria in Aqueous Solutions The Arrhenius Theory of Acids and Bases, Bronsted-Lowry and Lewis theory of Acids and Bases - Auto-ionization of water and pH - Ionization Constants of Weak Electrolytes and Polyprotic Acids - Common Ion Effect and Buffers - Hydrolysis Constants - Acid-Base Titration Curves. Solubility and Ksp relationship.
Analytical Chemistry: (12 lecture x 1 hr) Qualitative and quantitative analysis; Data Handling, Accuracy and precision; rounding off; determination of errors; indeterminate errors; standard deviation; propagation of error; significant figures and propagation of error; the confidence limit; the Q test; the correlation coefficient; detection limits and static of sampling Stoichiometric Calculations ,Review of fundamental concepts; concentrations of solutions and titer .. Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves, Complexometric Titrations, Formation constants of complexes; EDTA titrations, their

curves and their indicators. Oxidation–Reduction reactions and titrations Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications.

Chem 121 Introduction to Inorganic Chemistry: (2h lectures + 1h tutorial/ weekly)

Types of chemical reactions -Types of compounds - Nomenclature of inorganic compounds - Oxidation numbers and redox reactions - Acid strength; oxyacids and non oxyacides - Intermolecular forces - Chemical bonding; molecular orbital theory (MOT) - Molecular geometry.

Chem 131 Principles of Organic Chemistry (1): (2h lectures/ weekly)

Structure, Reactivity, isomerism, Preparation and Reactions of Alkanes, Alkenes, Alkynes, Aromatic hydrocarbons, Alkyl Halides, Alcohols, Ethers, Aldehydes and Ketones, Carboxylic acids, Carboxylic acid derivatives, Benzene derivatives (phenols – aryl Halides, ethers, aldehydes and ketones, carboxylic acids, carboxylic acid derivatives) and Amines.

BioChem 171 Chemistry and Metabolism of Carbohydrates: (2h lectures + 3h practical/ weekly)

Classification of carbohydrates, Properties of monosaccharides, Cyclic structure of monosaccharides, Isomerism, Sugar derivatives, Sugar acids, Sugar alcohols, Deoxy sugars, Amino sugars, Glycosides, Chemical reaction of monosaccharides, Disccharides, Reducing and Non-Reducing Disaccharides, Oligosccharides, Polysccharides, Homopolysaccharide, Carbohydrate Digestion and Absorption, Diabetes Mellitus Type 1 Diabetes Mellitus. Type 2 Diabetes Mellitus. Gestational Diabetes. Other types: Latent Autoimmune Diabetes in Adults. maturity-onset diabetes of youth. Secondary Diabetes Mellitus.Carbohydrates, Metabolism Glycolysis Kreb's Cycle Fermentation Alcoholic fermentation Lactate fermentation Gluconeogenesis Glycogenesis Glycogenolysis, The pentose phosphate pathway Oxidative phase Non-oxidative phase.

Second Level

Chem 211 Fundamentals of Analytical Chemistry: (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 102

Analytical objectives, Qualitative and quantitative analysis; the analytical process and validation of a method. Data Handling, Accuracy and precision; rounding off; determination of errors; indeterminate errors; standard deviation; propagation of error; significant figures and propagation of error; the confidence limit; the Q test; the correlation coefficient; detection limits and static of sampling Stoichiometric Calculations ,Review of fundamental concepts; concentrations of solutions and titer .. Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves. Complexometric Titrations, Formation constants of complexes; EDTA titrations, their curves and their indicators. Oxidation–Reduction reactions and titrations Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications

Chem 212 Fundamentals of Analytical Chemistry: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 102

Analytical objectives, Qualitative and quantitative analysis; the analytical process and validation of a method. Data Handling, Accuracy and precision; rounding off; determination of errors; indeterminate errors; standard deviation; propagation of error; significant figures and propagation of error; the confidence limit; the Q test; the correlation coefficient; detection limits and static of sampling Stoichiometric Calculations ,Review of fundamental concepts; concentrations of solutions and titer .. Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves. Complexometric Titrations, Formation constants of complexes; EDTA titrations, their curves and their indicators. Oxidation–Reduction reactions and titrations

Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications

Chem 213 Volumetric and gravimetric Analysis: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 102

Review of fundamental concepts; concentrations of solutions and titer Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves. Complexometric Titrations, Formation constants of complexes; EDTA titrations, their curves and their indicators. Oxidation–Reduction reactions and titrations Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications. General principles of gravimetric analysis; preliminary treatment; precipitation step, filtration and washing of the precipitate; drying or ignition of the precipitate; thermal analysis.

Chem 221 Chemistry of representative elements: (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 101

General properties of the elements. Metallurgy and isolation. Chemistry of hydrogen. Chemistry of the Alkali metals. Chemistry of alkaline earth metals. Chemistry of group (IV) elements. Chemistry of group (V) elements. Chemistry of group (VI) elements. Chemistry of halogens. Chemistry of inert gases. Applications.

Chem 230 Practical Organic Chemistry: (6h practical/weekly)
Pre-requisite: Chem 101

Investigation of Org. compounds (4 Weeks), solubility groups and IR (1 Week), Preparation of solid crystalline derivatives and identification of the unknown compound by comparing m.p's of compound and its derivatives with literature values (3 Weeks), confirmation of the compound identity by confirmatory tests designed by students through net-search (1 Week), final assessment (1 Week).

Chem 231 Physical Organic Chemistry (1): (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 101

Reactivity, Kinetics, and Mechanisms - Ionic Reactions - Nuclophilic Substitution reactions (SN^1, SN^2, SN^i) - Elimination reactions (E^1, E^2) - Electrophic aromatic substitution reactions - Nucleophilic aromatic substitution reactions – free radical reactions.

Chem 232 Stereochemistry & Physical Organic Chemistry (2): (2h lectures + 1h tutorial/weekly)
Pre-requisite: Chem 131

Stereochemistry: Stereoisomerism – Chirality - resolution and analysis of enantiomers and diastereomers - conformational isomerism - Spectroscopic determination of relative and absolute chirality.
Physical Organic: Nucleophilic addition to carbonyl compounds- Aldol reactions- Addition of Enolate anions to aldehydes and ketones- Nucleophilic addition-Elimination at the acyl carbon of carboxylic acid and their derivatives.

Chem 233 Spectroscopy of Organic compounds (1): (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 131

The Electromagnetic Spectrum - Ultraviolet spectroscopy - IR spectroscopy - Nuclear Magnetic Resonance spectroscopy - Mass Spectrometry - Applications on Structure Determination.

Chem 234 Principles of Organic Chemistry (2) : (3h lectures / weekly)
Pre-requisite: Chem 101

Structure, Reactivity, Preparation and Reactions of Alkanes, Alkenes, Alkynes, Aromatic hydrocarbons, Alkyl Halides, Alcohols, Ethers, Aldehydes and Ketones, Carboxylic acids, Carboxylic

acid derivatives, Benzene derivatives (phenols – aryl Halides, ethers, aldehydes and ketones, carboxylic acids, carboxylic acid derivatives) and Amines - Stereochemistry.

Chem 241 Chemical Thermodynamic: (2h lectures/ weekly)
Pre-requisite: Chem 102

The first law of thermodynamics, Reversible, irreversible processes. Adiabatic processes. Isothermal. P-V work. Heat Capacities, Relationship, The Joule-Thompson Expansion. Entropy: The second law of thermodynamics-Carnot cycle, Clausius inequality; quantitative measures of ΔS: entropy changes during the phase change. changes in entropy during isothermal expansions of an ideal gas, changes in entropy during the heating of an ideal gas; variation of ΔS with temperature - the third law of thermodynamics - absolute entropies; entropy and chemical processes; ΔS in chemical reactions. Free energy functions:- the free energy functions; Helmholtz free energy; Gibbs free energy; properties of the Gibbs free energy, pressure dependence of the Gibbs free energy, temperature dependence of the Gibbs free energy .Gibbs free energy for chemical reactions, Gibbs free energy and the equilibrium constant. Gibbs energy, entropy and enthalpy of mixing, liquid mixtures. Response of equilibria to pressure, response of equilibria to temperature (van't Hoff equation). Electrochemical work. Clapeyron and Clausius-Clapeyron equations.

Chem 242 Quantum Chemistry: (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 102

Introduction to Quantum theory and Its Origin – wave particle duality - Properties of Wave Function - Schrödinger Equation - postulates of quantum mechanics - quantum mechanical operators and Eigen value Equations - Probability and expectation Values - Particle in a one, two and three dimensional box - Heisenberg Uncertainty Principle - Rigid rotor model - Rotational motion - Qualitative treatment of simple harmonic oscillator model - vibrational motion - Angular momentum - Schrödinger Equation of hydrogen atom and hydrogen like ions - Schrödinger equation for many-electron atoms - The Born-Oppenheimer approximation - Variational principle - Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules.

Chem 243 Kinetic theory of gases – Phase rule: (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 102

Kinetic theory of gases, ideal gas model, kinetic theory of gases, equipartition theorem. Two-parameter Equations of State, Virial Coefficients, van der Waals interactions and Molecular Potentials, Temperature as a measure of Kinetic Energy, The Maxwell-Boltzmann distribution for molecular speeds , The Mean Free Path and Collision frequencies, Diffusion, viscosity, thermal conductivity . Brownian movement and Avogadro's number-theory of non-ideal behavior- principle of corresponding states. Partition Functions, Translational Partition Functions. Electronic Partition Functions. Vibrational Partition Functions. Rotational Partition Functions. Phase rule, Application of the thermodynamic concepts to the analysis of phase equilibrium, phase transformations, -Gibbs Phase Rule and phase diagrams in one-component system. Binary phase diagrams. Binary phase diagrams and Gibbs free energy curves. Binary solutions with unlimited solubility. Relative proportion of phases (tie lines and the lever principle).. Binary eutectic systems (limited solid solubility). Solid state reactions (eutectoid, peritectoid reactions). Binary systems with intermediate phases/compounds. Gibbs phase rule. Temperature dependence of solubility. Multi-component (ternary) phase diagrams.

Chem 244 Molecular Spectroscopy: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 102

Nature of Light and general principles - Rotational spectroscopy - vibrational spectroscopy - electronic spectroscopy - Applications in determining the structure and bonding of molecular compounds with emphasis on spectral interpretation skills needed for the structure elucidation - Nuclear magnetic resonance Spectroscopy - Electron spin Resonance spectroscopy.

BioChem 271 Chemistry and Metabolism of Lipids: (2h lectures / weekly)
Pre-requisite: Chem 101

Lipids of physiologic significance – Classification of Lipids- Chemistry of different molecules of lipids– Fatty acids- Lipoproteins- Eicosanoids – prostaglandins –Phospholipids - Membrane Fluidity - Membrane structure assembly- Functions- Blood lipids: Clinical importance and their disorders. Digestion, Absorption and Transport of Lipids- Lipid Storage - Metabolism of saturated and unsaturated Fatty acids and Eicosanoids - Metabolism of acylglycerol and sphingolipids – Metabolism of Keton bodies - Metabolism of Cholesterol – Synthesis of Bile Acids.

BioChem 272 Chemistry and Metabolism of Amino acids & proteins: (2h lectures + 3h practical/weekly)
Pre-requisite: Chem 101

α-Amino acids, Structures, physical and chemical properties, Amino-Terminal Sequence Determination, Peptide bonds, Protein formation and folding, Protein structures and stability, Proteins Classification, Chemical Digestion of Proteins, protein purification and sequence determination, protein chromatography, Transamination, amino acids synthesis and degradations, glucose-alanine cycle, Amino acid derived Metabolic Regulator Compounds, Urea cycle, Polyamnine Biosynthesis.

BioChem 273 Chemistry of Nucleic Acids and Metabolism: (2h lectures + 3h practical/weekly)
Pre-requisite: Chem 101

Chemistry and Biochemistry of Nucleic acids: general introduction on nucleic acids– Structural units of nucleic acids (mononucleotides) – Chemical composition of mononucleotides – Physico-chemical composition and properties of mononucleotides – Biomedical Importance Of Nucleotides Natural and some synthetic nucleotides and their uses in the treatment of some serious diseases. Purine Nucleotides Biosynthesis - Salvage of Purine Nucleotides - Regulation of Purine Nucleotides Synthesis- Catabolism of Purine Nucleotides and the fate of uric acid in different organisms - Pyrimidine Nucleotides Biosynthesis - Salvage of Pyrimidine Nucleotides - Regulation Pyrimidine Nucleotides Biosynthesis Catabolism of Pyrimidine Nucleotides - Clinical Significances of Nucleotide Metabolism - Interconversion of the Nucleotides.

BioChem 274 Chemistry of Vitamins: (2h lectures + 3h practical/weekly)
Pre-requisite: Chem 101

Introduction of vitamins, Definition, Sources of Vitamins, History of Vitamins, Naming of Vitamins, Classification of Vitamins, Eight water-soluble: B vitamin complex and vitamin C. Four fat-soluble: vitamins A, D, E, and K. Lipid-soluble Vitamins Vitamin A Vitamin D Vitamin E Vitamin K Water-soluble Vitamins: Vitamin B family: Vitamin B1 (thiamine): Vitamin B2 (Riboflavin): Vitamin B3 (Niacin) Vitamin B5 (pantothenic acid) Vitamin B6 (pyridine derivatives) Vitamin B7 (Biotin) Vitamin B9 (Folic acid) Vitamin B12 (Cobalamin) Vitamin C (ascorbic acid) comparison between water and fat soluble vitamins.

BioChem 275 Water and Mineral Metabolism: (2h lectures/weekly)
Pre-requisite: Chem 101

Acids – bases, pH and buffering systems, Fluid compartments in the body, Water balance, Acid – base balance Anion gab, Metabolic Acidosis, Lactic acidosis, Metabolic Alkalosis, Respiratory Acidosis, Respiratory Alkalosis, Mineral metabolisms Calcium Magnesium Iron Phosphorous Sulfur Sodium Chloride Potassium Iodine Fluorine Manganese Molybdenum Selenium Chromium Zinc Requirements of vitamins and minerals Reference ranges for blood tests and Minerals.

BioChem 276 Enzymes: (2h lectures + 3h practical/weekly)
Pre-requisite: Chem 101

History of Enzymology, Chemical Bonds and Reactions in Biochemistry, Structural Components of Enzymes, Kinetics of Single-Substrate Enzyme Reactions, Experimental Measures of Enzyme Activity, Reversible Inhibitors, Tight Binding Inhibitors, Enzyme Reactions with Multiple Substrates, Cooperativity in Enzyme Catalysis.

BioChem 277 Basics of Biochemistry (1): (2h lectures + 3h practical/weekly)
Pre-requisite: Chem 101

Concise Chemistry and Metabolism of Carbohydrates, Chemistry and Metabolism of Lipids, Concise Chemistry and Metabolism of Amino acids and proteins, Concise Chemistry and Metabolism of Nucleic Acids, Concise Chemistry and Metabolism of Vitamins, Concise Chemistry and Metabolism of Enzymes, Concise Chemistry and Metabolism of Hormones.

BioChem 278 Basics of Biochemistry (2) : (2h lectures/weekly)
Pre-requisite: Chem 101

Concise Chemistry and Metabolism of Carbohydrates, Chemistry and Metabolism of Lipids, Concise Chemistry and Metabolism of Amino acids and proteins, Concise Chemistry and Metabolism of Nucleic Acids, Concise Chemistry and Metabolism of Vitamins, Concise Chemistry and Metabolism of Enzymes, Concise Chemistry and Metabolism of Hormones.

Third Level

Chem 311 Basics of Chemical Analysis (1): (2h lectures + 1h tutorial/ weekly)
Pre-requisite: Chem 102

Analytical objectives, Qualitative and quantitative analysis; the analytical process and validation of a method. Data Handling, Accuracy and precision; rounding off; determination of errors; indeterminate errors; standard deviation; propagation of error; significant figures and propagation of error; the confidence limit; the Q test; the correlation coefficient; detection limits and static of sampling Stoichiometric Calculations ,Review of fundamental concepts; concentrations of solutions and titer .. Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves. Complexometric Titrations, Formation constants of complexes; EDTA titrations, their curves and their indicators. Oxidation–Reduction reactions and titrations Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications

Chem 312 Basics of Chemical Analysis (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 102

Analytical objectives, Qualitative and quantitative analysis; the analytical process and validation of a method. Data Handling, Accuracy and precision; rounding off; determination of errors; indeterminate errors; standard deviation; propagation of error; significant figures and propagation of error; the confidence limit; the Q test; the correlation coefficient; detection limits and static of sampling Stoichiometric Calculations ,Review of fundamental concepts; concentrations of solutions and titer .. Acid – Base titrations, Neutralization reactions of different acids with different bases and their titration curves. Solubility and Ksp - Relationship of Ion Product to Solubility – predicting. Precipitation titrations; their types and their curves. Complexometric Titrations, Formation constants of complexes; EDTA titrations, their curves and their indicators. Oxidation–Reduction reactions and titrations Oxidation–Reduction reactions; electrochemical cells; electrode potentials; the potential of electrochemical cell; redox titrations curves; indicators and applications

Chem 313 Gravimetry and thermogravimetry : (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 212

General principles; preliminary treatment; precipitation step, filtration and washing of the precipitate; drying or ignition of the precipitate; thermal analysis.

Chem 314 Chromatographic Separation-Electrochemical analysis: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 212

Chromatographic Separation Techniques: Principles of chromatography; classification of chromatography; techniques of column chromatography; column efficiency in chromatography; size exclusion chromatography, ion exchange chromatography; gas chromatography; gas chromatography-mass spectrometry; high performance liquid chromatography (HPLC); super critical

fluid chromatography; thin–layer chromatography; paper chromatography; electrophoresis and capillary zone.
Electrochemical analysis: Introduction; potentiometry, voltametry, polarography, electrodeposition, coulometry and conductometry.

Chem 315 Electrochemical and Spectrochemical Analysis: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 213

Electrochemical analysis: Introduction; potentiometry, voltametry, polarography, electrodeposition, coulometry and conductometry.
Spectrochemical Analysis: Overview of spectroscopic theory and techniques.Ultra –violet and visible spectroscopy - Atomic absorption and emission - X-ray fluorescence spectroscopy - Infrared spectroscopy - Application.

Chem 316 Bio analyses: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 211

The course focuses on the most important aspects in all steps of an analytical method to determine biological active compounds (endogeneous compounds, environmental pollution, drugs etc.) in various biological matrices (like serum, urine, cell culture) and environmental samples (water).

Chem 317 Instrumental analyses: (3h lectures+1h tutorial/weekly)
Pre-requisite: Chem 102

Overview of spectroscopic theory and techniques - Ultra –violet and visible spectroscopy - Atomic absorption and emission - X-ray fluorescence spectroscopy - Vibrational spectroscopy (FT-IR, Raman) - Application.

Chem 321 Chemistry of Transition Metals and Complexes: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 221

Transition Metals: General properties of transition metals (d-block elements)- Chemistry of scandium, titanium, vanadium, chromium, manganese, iron ,cobalt, nickel, copper and zinc groups in terms of their electronic configuration, different oxidation states, physical and chemical properties of the elements and their compounds. Structure of some important compounds. Isolation of elements. Uses and applications.
Complexes: Werner theory of coordination chemistry- Classification of ligands and complexes- Nomenclature- Coordination number and stereochemistry of complexes- preparation of complexes- Isomerisms among inorganic complexes- Detection of complexes in solid and solution- Nature of metal-ligand bonding in complexes- Valence bond, Crystal field and ligand field theories. Stability of complexes- Inorganic reaction mechanism.

Chem 322 Chemistry of f-block elements and organometallic compounds: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 221

F-block elements: General properties of lanthanides and actinides- Electronic configuration- Physical and chemical properties of lanthanides- Extraction of lanthanides- Methods of separation- Application in industry- Properties of actinides- The chemistry of some elements- Trans- uranium elements.
Organometallic compounds: Organometallic compounds of: 1) non transition metal compounds, ii) alkene, iii) delocalized carboxylic groups, iv) alkyne, v) allyl and carbene compounds- Nomenclature of organometallic compounds- Application in homogeneous catalytic reactions.

Chem 323 Mechanism of Inorganic Reactions– Introduction to Bioinorganic chemistry: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 221

Inorganic Reaction Mechanism : Introduction- Mechanism and structure - Electron transfer reactions - Oxidative addition - Reductive elimination - Tetrahedral substitution - Substitution in square planar complexes - Trans effect in square planar complexes - Substitution in octahedral complexes.
Introduction to Bioinorganic Chemistry: What is Bioinorganic Chemistry - Coordination compounds; review in geometry - Elements in biological systems - Elements of life and elemental - functionality in biological systems - Osmosis and dialysis - Acidosis and alkalosis - Iron in humans - Hemoglobin and Myoglobin – Chlorophyll - Co-enzyme B12.

Chem 324 Coordination Chemistry and the Chemistry of Transition Metals: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 221

Coordination Chemistry: Werner theory of coordination chemistry- Classification of ligands and complexes- Nomenclature- Coordination number and stereochemistry of complexes- preparation of complexes- Isomerisms among inorganic complexes- Detection of complexes in solid and solution- Nature of metal-ligand bonding in complexes- Valence bond, Crystal field and ligand field theories. Stability of complexes- Inorganic reaction mechanism.
The **Chemistry of Transition Metals** (d-Block elements) :General properties of transition metals (d-block elements)- Chemistry of scandium, titanium, vanadium, chromium, manganese, iron ,cobalt, nickel, copper and zinc groups in terms of their electronic configuration, different oxidation states, physical and chemical properties of the elements and their compounds. Structure of some important compounds. Isolation of elements. Uses and applications.

Chem 330 Practical Organic Chemistry (2) : (6h practical/weekly)
Pre-requisite: Chem 230

Physical Organic mechanistic studies (2 Weeks), spectroscopy workshop (2 Weeks), synthetic Organic Chemistry (3 Weeks), dyes and dying (2 Weeks), final assessment (1 Week).

Chem 331 Heterocyclic compounds: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 231

Importance and Nomenclature of heterocyclic compounds - Three membered heterocyclic rings with one heteroatom - Five membered heterocyclic rings with one heteroatom (pyrrole, furan and thiophene) - Benzoderivatives of five-membered heterocycles with one heteroatom - Five membered heterocyclic rings with two or more heteroatoms - Six membered heterocyclic rings with one heteroatom and their benzoderivatives (pyridines, quinolines and isoquinolines) - Six membered heterocyclic rings with two or more heteroatoms.

Chem 332 Organic synthesis & organometallic chemistry: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 232

Organic synthesis: Formation of carbon - Carbon bonds: (a) Base – catalyzed condensation: Condensation of carbanions with aldehydes, ketones and esters – The alkylation of carbanions – Addition of carbanions to activated olefins. (b) Acid – catalyzed condensations: The self-condensation of olefins - Friedel Craft's reactions - perkin reaction – condensation of aldehydes and ketones - Mannich reaction. (c) Enolates: Control of extent of alkylation - Michael reactions – Robinson annelation.
Organometallic chemistry: Importance and Nomenclature of Organometallic compounds - Organolithium reagents - Grignard reagents - Organosilicon compounds – Organotin compounds - Using organometallics in organic synthesis.

Chem 333 Applied Organic Chemistry: (2h lectures/weekly)
Pre-requisite: Chem 101

Synthetic and botanical insecticides – fungicides – herbicides – fumigants – rodenticides – nematicides – Industry of fats and fatty oils (oils, fats, waxes, soap, stearic acid, candle, oleomargarine, glycerine) – Industry of the essential oil and resins (perfumes, varnishes, printing inks, miscellaneous products from resins and essential oils).

Chem 334 Dyes and fibers Chemistry : (2h lectures/weekly)
Pre-requisite: Chem 101

Dyes: color, photoelectric theory, complement-dry light, classification of dyes according to chemical constitution - nitroso, nitro dyes, azodyes (monoazo and disazo dyes) triarylmethane dyes and related dyes - xanthenedyes, vat dyes, indigo dyes, anthraquinone dyes, introduction to reactive dyes, photographic sensitizers.
Fibers: textile fibers - fiber structure- fiber properties fiber identification - classification of fibers- cellulose **Fibers:** cotton flax, hemp jute-man - made cellulosic fibers- rayon acetate and triacetate protein fibers- wool and silk fibers – Synthetic fibers (Polyester fiber, nylon fibers, acrylic fibers, spandex fibers, polypropylene fibers) - the processing of textiles purification and preliminary singeing: desizing, scouring, bleaching and mercerizing dyeing - the kinds of forces by which dye molecules are bound to the fiber.

Chem 335 Special topics in Organic Chemistry: (2h lectures/weekly)
Pre-requisite: Chem 101
A special topic in Organic Chemistry has to be selected according to labor market requirements, or the new advances on frontier, specified and approved by faculty council.

Chem 336 Carbohydrate chemistry: (2h lectures/weekly)
Pre-requisite: Chem 231

Importance and Structures of Carbohydrates - Emil Fisher's determination of carbohydrate structures - Formation of sugar rings, Haworth structures; conformation of carbohydrates - Reactions of carbohydrates at C-1, mutarotation and other reactions - Reactions of carbohydrates at C-1, oxidation and reduction, addition - Effects of acids and alkali on carbohydrates. Reactions of carbohydrates at C-1, formation of acetals; structures of disaccharides - Reactions of other carbons: formation of esters & ethers - Specific reactions of primary alcohols and modification of primary alcohols - Formation of anhydrides, isopropylidienes, and benzilidenes - Synthesis of glycosidic linkages, modifications at C-2 - Chemical modifications at C-3, C-4, and C-5 - Chemical tests and quantitative methods for analyzing carbohydrates. Polysaccharide structures - Structure of starch and starch granules - Structure of cellulose, chitin, murein, xanthan, and algin - Structures of other α-linked polysaccharides: pullulan, dextrans, alternan - Glycogen and glycosaminoglycans - Structure and function of glycoproteins.

Chem 337 Spectroscopy of Organic compounds (2) & multistep synthesis: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 233

Spectroscopy: Basic principles and methods of NMR - chemical shift – spin spin coupling – coupling constants – spin decoupling – relaxation, relaxation times. Recognition of structural fragments by NMR - identifying functional groups from ^{1}H chemical shifts. ^{13}C chemical shifts, ^{15}N chemical shifts) – relative configuration and conformation (HH coupling constants, CH coupling constants, NH coupling constants). Problems: application of one-dimensional ^{1}H NMR spectra – Application of ^{1}H and ^{13}C NMR spectra to different molecules.
Multistep synthesis: Retrosynthetic analysis - synthesis backwards - multiple step syntheses - donor and acceptor synthons - two-group C–C disconnections - 1,5-related functional groups – "Natural reactivity" and "umpolung". 2-Nature is asymmetrical - nature in the looking-glass - resolution can be used to separate enantiomers - the chiral pool-Nature's "ready-made" chiral centers - Asymmetric synthesis - Chiral reagents and chiral catalysts – Problems.

Chem 338 Spectroscopy of Organic compounds: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 231

The Electromagnetic Spectrum - Ultraviolet spectroscopy - IR spectroscopy - Nuclear Magnetic Resonance spectroscopy - Mass Spectrometry - Applications on Structure Determination.

Chem 341 Electrochemistry (1): (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 101

Reversible processes; Reversible galvanic cells- EMF and its measurements- types of electrodes- relation between cell potential and free energy- types of cells (concentration cells- electrochemical cells-cells with and without transfer)" applications of EMF measurements. Irreversible processes; Types of overpotential (ohmic-concentration-activation) electrode kinetics- Tafel equation- exchange current-mechanism of hydrogen and oxygen reduction- storage cells (reversible and irreversible)- fuel cells.

Chem 342 Electrochemistry (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 241

Reversible processes; Reversible galvanic cells- EMF and its measurements- types of electrodes- relation between cell potential and free energy- types of cells (concentration cells- electrochemical cells-cells with and without transfer)" applications of EMF measurements. Irreversible processes; Types of overpotential (ohmic-concentration-activation) electrode kinetics- Tafel equation- exchange current-mechanism of hydrogen and oxygen reduction- storage cells (reversible and irreversible)- fuel cells.

Chem 343 Chemical kinetics: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 102

Elementary reaction kinetics: Definition of Elementary reactions - The molecularity of a reaction - Molecularity vs. order -The rate laws Variations of concentrations with time. The determination of the reaction order from the integration method - Fractional lifetime method - The isolation method - Comparison of these methods. The temperature dependence of reaction rates (The Arrhenius equation). Energy of activation, calculation of activation energies. Potential energy surfaces. Consecutive elementary reactions - Mechanism of chemical reactions -The rate-determining step - The steady state approximation. Kinetic of revisable reactions. Chain Reactions: Introduction - The rate laws of chain reactions: Example of a chain reaction having a complicated rate law - The formation of HBr from hydrogen and bromine. Special case: Explosions. parallel reactions .A theoretical approach to chemical kinetics: Collision theory -The reaction profile in the Collision Theory-Derivation of the rate law through the Collision theory - Activated complex theory -The reaction profile in the ACT- Derivation of the rate law through the-ACT (the thermodynamic derivation) -The activated complex theory and reactions between ions. The Lindemann Hinshelwood Mechanism - First-order gas phase kinetics Unimolecular Reactions. Influence of solvent and pressure on rates in solution - Primary salt effect in ionic reactions.

Chem 344 Surface chemistry and its applications: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 102

Liquid interfaces, surface tension and surface free energy, measurement of surface and interfacial tension, spreading coefficient; adsorption at liquid interface, study of surfactants including applications like wetting foaming and antifoaming agents, hlb classification, solubilization, detergency, adsorption on solid interface, solid-gas and solid-liquid interfaces, complex films, electrical properties of interfaces. The terminology of surface chemistry is introduced. Liquid-gas interface and liquid-liquid interface. Measurement techniques for surface and interfacial tension are discussed. The importance of interfacial free surface science is explained through relevant examples. Wetting, detergency, micelle formation, emulsions, microemulsions, foam stability, ore flotation, and adsorption at the gas-solid and liquid-solid interfaces. Liquid interfaces: interfacial tension, adsorption at interfaces, surface active agents, adhesion and cohesion, wetting and contact angle, spreading, nucleation processes.

Chem 345 Statistical Dynamics: (2h lectures/weekly)
Pre-requisite: Chem 102

Statistical Mechanics, Introduction to statistical thermodynamics - postulates, microcanonical, canonical and grand canonical ensembles, partition function and thermodynamics, fluctuation, statistical mechanics of independent particles - degeneracy of energy levels and equilibrium distribution function in Maxwell-Bolzmann, Fermi-Dirac and Bose-Einstein statistics.
Statistical mechanics of mono-,diatomic and polyatomic ideal gas -contribution of rotation, vibration and translation to partition function, electronic contribution to the specific heat of diatomic gases. Solids - vibrational contribution to the specific heat of solids, Einstein-Born-Debye model.

Classical statistical mechanics - phase space, Liouville's theorem. Intermolecular interaction. Application to - imperfect gases, liquid structure, chemical equilibrium and phase equilibrium. Transport properties in gases and condensed phases - kinetic theory of gases, diffusion in solution, transport in electrolyte solutions - Debye-Huckel Theory; Beyond the Debye-Huckel approximation - Debye-Huckel-Bronsted theory, Debye-Huckel-Onsager theory.

Chem 346 Photochemistry and Nanochemistry: (2h lectures/weekly)
Pre-requisite: Chem 102

Photochemistry: The interaction of light with matter. Quantum theory for the absorption of electromagnetic radiation. Electronic transitions. (pi, pi*) and (n,pi*) states. Spin multiplicity of excited states. State (Jablonski) diagrams. Emission spectra. Fluorescence and phosphorescence. Relationship to absorption spectra. Experimental measurement techniques: the spectrofluorimeter and Deactivation of excited states. Radiative and radiationless transitions. Internal conversion and inter-system crossing. Types and mechanisms of electronic energy transfer. Kinetics of photochemical processes. Rate constants. Quantum yields and actinometry. Excited state lifetimes and their measurements. Flash photolysis. Quenching processes: the Stern- Volmer equation. Photosensitization. Rates of energy transfer: the diffusion-controlled limit and the Debye equation. Use of sensitisers. Norrish type I and II processes. Comparison of S1 and T1 biradicals. Photofragmentation reactions: the Barton reaction.
Nanochemistry: Nanotechnology, nanomaterials, mesoporous, microporous and macroporous materials. Nanoscale, Nanometer, Nanoparticles, Nanotubes, Thin films, Nanocomposites، Nanostructured bulk materials. Synthesis of nanoparticles, mesoporous materials and composites (Bottom Up and Top Down Production). Synthesis by anodization, hydrothermal, convention heating، deposition-precipiation methods.

Chem 347 Special topics in Physical Chemistry: (2h lectures/weekly)
Pre-requisite: Chem 102

A special topic in Physical Chemistry has to be selected according to labor market requirements, or the new advances on frontier, specified and approved by faculty council.

BioChem 371 Hormones: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 272

Characteristics of Hormonal Systems - Diversity of The Endocrine System - Mechanism of Action - Classes: Hypothalamic Hormones - Pituitary Hormones: Anterior pituitary hormones & Posterior Pituitary -Thyroid Hormones - Adrenal cortex Hormones -Adrenal Medulla Hormones - Pineal gland Hormones - Pancreatic Hormones - Gonadal Hormones: Androgens & Estrogens - Placenta Hormones - Gastro-intestinal Hormones - Hormones that Regulate Calcium Metabolism (Hormones of Parathyroid gland) - Thymus Gland Hormone – Functions & Roles in Metabolic Reactions, Clinical Significances and disorders.

BioChem 372 Genetic information and its applications: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 101

Conformation and structure in space of nucleic acids DNA & RNA - Alternative DNA Structures - Basic Properties of DNA - Plasticity in DNA Structure - DNA topology - Chromatin structure - DNA Replication - DNA and its role in the transfer of the genetic characters –- RNA Secondary Structure - Types of RNA – Protein Expression – Ribosomes - Protein Synthesis - DNA–Protein Interactions- Transmission Genetics- Basic and Advanced Principles of Heredity - The Chromosomal Basis of Heredity.

BioChem 373 Food Chemistry and analysis: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 272

Food safety. Food labelling regulations. Food spoilage. Causes of food spoilage. Natural decay in foods. Contamination by micro-organisms. Effects of spoilage on the various food commodities. Biochemistry of food spoilage. Food additives. Nutritional additives. Processing agents and nutritional effects of food processing. Food preservatives and their risks. Natural preservatives. Chemical

preservatives. Dangers of preservatives. Food preservation techniques. Sensory agents. Flavourings. Food colorants and their risks. Sweetners and their risks.

BioChem 374 Molecular immunology: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 101

Introduction, Cells and Tissues Involved in the Immune Response, Major Histocompatibility Complex, The Induction of an Immune Response, Antigens, Lymphocytes, and Accessory Cells, Immunoglobulin Structure Biosynthesis, Metabolism, and Biological Properties of Immunoglobulins, Genetics of Immunoglobulins Antigen-Antibody Reactions, Phage display and monoclonal antibody production, The Complement System Lymphocyte Ontogeny and Membrane Markers .

BioChem 375 Biotechnology and its applications: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 273

General introduction on biotechnology – Basic techniques used within biotechnology laboratories - Applications of DNA/RNA technology- Biotechnology and Drug Discovery - Basic processes used in genetic engineering - Methods used in obtaining gene products - Forensic Biotechnology (The role of biotechnology in the field of forensic science and forensic medicine) - Microbial Biotechnology (bioremediation, bioterrorism, infectious diseases) - Enzyme technology - Applications of biotechnology - Agricultural Biotechnology & Genetically Modified Food - Biotechnology and the Developing World - Environmental Impact of Biotechnology.

BioChem 376 Body fluids: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 101

Fluid compartments in the body and definition of different body fluids. Blood composition and function. Erythropoiesis stages, regulation and factors affecting. Anemias. Hemoglobin types and metabolism. Blood coagulation and fibrinolysis. Blood indices. Leucopoiesis stages, regulation and factors affecting. Tissue macrophage system. Blood groups and blood transfusion. Urine composition and function. Breast milk composition and biological importance. Saliva. Synovial fluid. Amniotic fluid and the related disorders. Lymph. Tears.

Fourth Level

Chem 400 Research Project and Essay: (2h lecture weekly for one term)

Reviewing a research project in chemistry to be selected by the department, preparing a written essay on it.

Chem 401 Research Project and Essay: (1h lecture weekly for one term)

Reviewing a research project in chemistry to be selected by the department, preparing a written essay on it.

Chem 411 Preconcentration and Spectrochemical Analysis: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 212

Overview of spectroscopic theory and techniques.Ultra - violet and visible spectroscopy - Atomic absorption and emission - X-ray fluorescence spectroscopy - Infrared spectroscopy - Application.

Chem 412 Environmental Chemistry and Nano-applications (1): (2h lecture weekly)
Pre-requisite: Chem 102

Environmental Chemistry: This course is designed to the present environmental problems and the role of chemical analysis in environmental monitoring. It deals with the various analytical methods employed in the detection and analysis of chemical pollutants (toxic metals, pesticides, phenolic). Industrial wastes in the atmosphere, hydrosphere, lithosphere, and biosphere. The qualitative and quantitative aspects of common and individual pollutants analysis will be emphasized. Radioactive pollutants (airborne dust and gases) will be covered.

Nano-applications: Characterization of nanomaterials by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Brunauer, Emmett and Teller (BET) adsorption method, Thermogravimetric Analysis (TGA), Atomic Absorption Spectroscopy (AAS), Ultraviolet-Visible Spectroscopy (UV-Vis) and Fourier Transform Infrared (FTIR) spectroscopy etc. Importance of nanotechnology with special reference to environmental pollution, gas sensors, solar cells, catalysis.

Chem 413 Environmental Chemistry and Nano-applications (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 213

Environmental Chemistry: This course is designed to the present environmental problems and the role of chemical analysis in environmental monitoring. It deals with the various analytical methods employed in the detection and analysis of chemical pollutants (toxic metals, pesticides, phenolic). Industrial wastes in the atmosphere, hydrosphere, lithosphere, and biosphere. The qualitative and quantitative aspects of common and individual pollutants analysis will be emphasized. Radioactive pollutants (airborne dust and gases) will be covered.
Nano-applications: Characterization of nanomaterials by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Brunauer, Emmett and Teller (BET) adsorption method, Thermogravimetric Analysis (TGA), Atomic Absorption Spectroscopy (AAS), Ultraviolet-Visible Spectroscopy (UV-Vis) and Fourier Transform Infrared (FTIR) spectroscopy etc. Importance of nanotechnology with special reference to environmental pollution, gas sensors, solar cells, catalysis.

Chem 414 Special topics in Analytical Chemistry: (2h lecture weekly)
Pre-requisite: Chem 102

A special topic in Analytical Chemistry has to be selected according to labor market requirements or the new advances on frontier, specified and approved by faculty council.

Chem 415 Separation Techniques and Spectrochemical Analysis (1): (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 102

Separation Techniques: The purpose of this course is to introduce the student to the theory and application of separation methods. This course will cover the following topics .Classification of separation methods: separation by precipitation, distillation, and solvent extraction. Theory and application of chromatography. Gas Chromatography. High Performance liquid Chromatography (HPLC) . Thin –Layer Chromatography. Supercritical fluid Chromatography (SFC) . Electrophoresis.
Spectrochemical Analysis: Overview of spectroscopic theory and techniques.Ultra –violet and visible spectroscopy - Atomic absorption and emission - X-ray fluorescence spectroscopy - Infrared spectroscopy - Application.

Chem 416 Separation Techniques and Spectrochemical Analysis (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 311

Separation Techniques: The purpose of this course is to introduce the student to the theory and application of separation methods . This course will cover the following topics .Classification of separation methods: separation by precipitation, distillation, and solvent extraction. Theory and application of chromatography. Gas Chromatography. High Performance liquid Chromatography (HPLC) . Thin –Layer Chromatography. Supercritical fluid Chromatography (SFC) . Electrophoresis .
Spectrochemical Analysis:- Overview of spectroscopic theory and techniques.Ultra –violet and visible spectroscopy - Atomic absorption and emission - X-ray fluorescence spectroscopy - Infrared spectroscopy - Application.

Chem 421 Group theory and its applications - Introduction to catalytic Inorganic Chemistry: (2h lecture weekly)
Pre-requisite: Chem 221

Group theory and its applications: Symmetry elements and symmetry operations - point groups - Mathematical definitions and Group theory - Character table - Reducible representation of molecular orbital - Irreducible representations of C2V - Group theory and vibration Spectroscopy.
Introduction to Catalytic Inorganic Chemistry: The difference between catalysts and oxidands - Types of catalysis processes - Metal complexes as catalysts - Advantages of heterogeneous catalysis, turn over number and turn over number per time - Optimum conditions for heterogeneous catalysis - Oxidation of alcohols, aldehydes and ketones - Large scale catalysis and industrial applications.

Chem 422 Electronic spectra and magneto chemistry: (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 221

Electronic spectra: Introduction – types of spectra – ligand – Field spectra – Russell – Saunders states – selection rule – terms arising in ligand field – spectra of d^1 , d^9 – spectra of d^2 , d^8 – spectra of d^3 , d^7 – spectra of d^5 .
Magneto Chemistry: Magnetic properties of elements and compounds- Magnetic susceptibility- Paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism- Measurement of magnetic moments- The effect of temperature on the magnetic moments- Orbital contribution- The anomalous values of magnetic moments and stereochemistry of complexes- Applications.

Chem 423 Industrial Inorganic Chemistry: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 221

Application of chemical engineering in the manufacture of ceramic materials, glass and inorganic binders. Processings, principles of chemical and physical of high temperature processes in the manufacture. Equipements for treatment of raw materials and kiln systems.

Chem 424 Chemistry of Inner-transition Metals and bonding in complexes (1): (2h lectures+1h tutorial/weekly)
Pre-requisite: Chem 221

Structural Inorganic Chemistry : Nature of metal-ligand bonding in complexes- Valence bond theory- Limitations and disadvantages of the theory- Crystal field theory- Calculation of crystal field stabilization energy- Ligand field theory- Comparison between the theories- Geometry of the complexes- Applications.f-block Elements: General properties of lanthanides and actinides- Electronic configuration- Physical and chemical properties of lanthanides- Extraction of lanthanides- Methods of separation- Application in industry- Properties of actinides- Spectral and magnetic properties of actinides- The chemistry of some elements- Trans- uranium elements.

Chem 425 Chemistry of Inner-transition Metals and bonding in complexes (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 221

Structural Inorganic Chemistry : Nature of metal-ligand bonding in complexes- Valence bond theory- Limitations and disadvantages of the theory- Crystal field theory- Calculation of crystal field stabilization energy- Ligand field theory- Comparison between the theories- Geometry of the complexes- Applications.f-block Elements: General properties of lanthanides and actinides- Electronic configuration- Physical and chemical properties of lanthanides- Extraction of lanthanides- Methods of separation- Application in industry- Properties of actinides- Spectral and magnetic properties of actinides- The chemistry of some elements- Trans- uranium elements.

Chem 430 Practical Organic Chemistry (3): (6h practical/ weekly)
Pre-requisite: Chem 330

Natural products' Chemistry (2 Weeks), polymers' Chemistry (2 Weeks), petroleum Chemistry (2 Weeks), carbohydrates' Chemistry (1 Week), spectroscopy workshop (1 Week), multistep synthesis (1 Week), final assessment (1 Week).

Chem 431 Natural Products Chemistry: (2h lectures / weekly)
Pre-requisite: Chem 231

Definition, classification of natural products. Biosynthetic pathways (shikimic, mevalonic, acetate) of natural products. Terpenoids (definition, isoprene rule, exceptions of special isoprene rule, isolation, classification, methods of structure elucidation, examples for different terpenes). Terpenoids (structure elucidation and synthesis of selected terpenoids). Steroids (classes, stereochemistry, structure elucidation of selected steroids, sex hormones, adrenocortical hormones). Alkaloids (introduction, classification, isolation, structure elucidation of selected alkaloids). Shikimates (C6-C1, C6-C2, C6-C3, compounds containing shikimate ring, structure elucidation of some flavonoids).

Chem 432 Polymer chemistry: (2h lectures / weekly)
Pre-requisite: Chem 231

Basic principles - introduction - definitions – polymerization processes-polymerization of unsaturated olefins or cyclic -monomers - step - growth polymerization - free radical vinyl polymerization - kinetics of the free radical vinyl polymerization for radical, mechanism of free radical polymerization, chain transfer reactions, auto inhibition, polymerization of dienes, copolymerization, kinetics of the free radical polymerization, ionic vinyl polymerization, anionic polymerization, mechanism and reactivity in anionic polymerization, stereochemistry of anionic polymerization of dienes, polymerization technique suspension, emulsion, gas and solid phase polymerization, complex catalyst systems, ring opening polymerization molecular weight, Measurement of number average molecular weight, molecular weight distribution. Chemical structure and polymer properties, cross linking, glass transition temperature reactions of vinyl polymers, ring opening of functional group, conformation of molecules, factors determining chain flexibility.

Chem 433 Petroleum chemistry and petrochemicals: (2h lectures / weekly)
Pre-requisite: Chem 131

Petroleum chemistry: Composition of petroleum hydrocarbon constituents (paraffin's, aromatics, apothems) non-hydrocarbon constituents (sulphur, nitrogen, oxygen, and metallic compounds together with resinous and asphaltic materials) - specifications of petroleum and its products-classification of crude petroleum (according the chemical composition and the sulphur percentage) some physical aspects concerning petroleum fuels (diesel index, cetane number and octane number of motor and aviation fuel) - manufacturing processes and oil refinery - separation processes – distillation - absorption – adsorption - solvent extraction - conversion processes - production of motor and jet fuels –cracking – reforming - isonierisation - refining and treating processes - refining of light petroleum products - removal of H_2S, of mercaptans, sweetening - and desulphurization processes, and hydrogen treatment - refining of lubricating oils - acid treatment, clay treatment and dewaxing - miscellaneous refining processes (water removal, and stability of gasoline) - motor aviation, jet and diesel fuels composition, volatility, combustion and stability – characterization tests of petroleum products.
Petrochemicals: Types of reactors used in petrochemical processes - Types of catalysts used in petrochemical processes - Raw materials of petrochemicals - Types of Petroleum processes (Oxidation, Nitration, Halogenation, Sulphonation, Sulphoxidation and Sulphohalogenation of hydrocarbons, Isomerization reaction, Alkylation processes) - Some petrochemical products (Detergents – Monomers – Insecticides - Synthetic fibers - Rubber and plasticizers - Paints and solvents – Explosives).

Chem 434 Pericyclic reactions and Photochemistry: (2h lectures / weekly)
Pre-requisite: Chem 231

Pericyclic reactions: Organic reactions and orbital symmetry - concerted and stepwise reactions - theory of concerted reactions - molecular orbital theory - pericyclic reactions - general rules for pericylic reactions - the Woodward Hoffmann selection rules - frontier orbital approach (HOMO - LUMO), the energy correlation diagram approach, the aromatic transition state concept - aromaticity and aromatic character - valence bond theory of aromaticity - molecular orbital theory of aromaticity - non-benzenoid aromatics - electrocyclic reactions - cycloadditions - sigmatropic rearrangements.
Photochemistry: Excitation and the excited state - Intramolecular reactions of the olefinic bond: gepmetrical isomerism – cyclization reactions of conjugated olefins – rearrangements – 1,4-dienes and the di-π-methane rearrangement - rearrangements – 1,5-dienes. Intramolecular reactions of the carbonyl group: saturated acyclic and side chain carbonyl compounds – saturated cyclic carbonyl compounds – unsaturated carbonyl compounds – cyclohexadienones. Intermolecular cycloaddition reactions. Oxidation, reduction substitution and elimination reactions: Incorporation of molecular

oxygen – oxidative coupling – reduction reactions – substitution reactions – molecular rearrangements involving elimination and substitution – formation of reactive intermediates by molecular elimination.

Chem 435 Pollution and Chemotherapy: (2h lectures / weekly)
Pre-requisite: Chem 231

Pollution: Some concepts and principles of Chemistry involved in environmental processes, Chemistry related to atmosphere, hydrosphere and lithosphere, Pollutants, Atmospheric pollution (Air pollutants, Chemistry involved in Green-house effect, Ozone depletion, Acid rain and Photochemical smog), Air quality standards, Aquatic pollution (Aquatic pollutants, eutrophication, Chemical speciation), Techniques of monitoring air pollutants and aquatic pollutants, Methods for minimizing pollution, Treatment methods for sewage and industrial effluents, Treatment of water for domestic use.
Chemotherapy: Approaches to the problem of finding a drug to compact a particular disease - disinfectant drugs - antibacterial agents – sulphonamides - sulphanilamide - sulphapyridine - sulphathiazole - sulphadiazine - sulphamathzine -sulphaguanidine - prontosil - prontosils - antimalarials - plasmoquin, mepacrin proguanil - arsenical drugs - antibiotics - thepenicillins - syntetic penicillins (cephalosporinic, streptomycin, tetracycline, chloramphenicol) - five-membered heterocycles derivatives of pylrolidine, nitrofurans, oxazolidinediones and isoxazole, pyrazolones and pyrazolodiones.

Chem 436 Natural Products Chemistry & Heterocyclic compounds: (2h lectures / weekly)
Pre-requisite: Chem 231

Natural Products Chemistry: Definition, classification of natural products. Biosynthetic pathways (shikimic, mevalonic, acetate) of natural products. Terpenoids (definition, isoprene rule, exceptions of special isoprene rule. Terpenoids (structure elucidation and synthesis of some terpenoids). Steroids (classes, structure elucidation of some steroids). Alkaloids (introduction, isolation, structure elucidation of some alkaloids). Shikimates (C6-C1, C6-C2, C6-C3, compounds containing shikimate ring, structure elucidation of some flavonoids).
Heterocyclic compounds: Importance and Nomenclature of heterocyclic compounds - Three membered heterocyclic rings with one heteroatom - Five membered heterocyclic rings with one heteroatom (pyrrole, furan and thiophene) - Benzoderivatives of five-membered heterocycles with one heteroatom - Six membered heterocyclic rings with one heteroatom and their benzoderivatives (pyridines, quinolines and isoquinolines).

Chem 437 Polymer Chemistry, Petroleum & Petrochemicals: (2h lectures / weekly)
Pre-requisite: Chem 231

Polymer chemistry: Introduction - basic principles - polymerization of unsaturated olefins - step growth polymerization - free radical polymerization - chain transfer reactions - polymerization of dienes - copolymerization - ionic vinyl polymerization - anionic polymerization and its stereochemistry - polymerization techniques - molecular weight measurements - chemical structure and polymer properties.
Petroleum chemistry: Composition of petroleum hydrocarbon constituents (paraffin's, aromatics, apothems) - non-hydrocarbon constituents (sulphur, nitrogen, oxygen, and metallic compounds together with resinous and asphaltic materials) - classification of crude petroleum (according the chemical composition and the sulphur percentage) some physical aspects concerning petroleum fuels (diesel index, cetane number and octane number of motor and aviation fuel) - oil refinery - refining of light petroleum products - refining of lubricating oils - acid treatment, clay treatment and dewaxing - miscellaneous refining processes (water removal, and stability of gasoline) - motor aviation, jet and diesel fuels composition, volatility, combustion and stability.
Petrochemicals: Types of reactors used in petrochemical processes - Raw materials of petrochemicals - Types of Petroleum processes (Oxidation, Nitration, Halogenation, Sulphonation, Sulphoxidation and Sulphohalogenation of hydrocarbons) - Some petrochemical products (Detergents – Monomers – Insecticides - Synthetic fibers - Rubber and plasticizers).

Chem 441 Catalysis and its applications: (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 344

Catalysis : Criteria for Catalysis - Homogeneous Catalysis, acid-base, Enzymatic catalysis, Catalysis by metal salts, Heterogeneous catalysis - concepts of promoters, inhibitors and poisoning, , Industrially important process. Theories of Catalysis. Introduction - Homogeneous catalysis – Auto – catalysis . Kinetic and mechanism of homogeneous catalysis. Heterogeneous catalysis- kinetics and mechanisms- absolute rates of surface reaction The rates of surface processes Catalytic activity at surfaces. Shape selective catalyst. Langmuir - Hinshelwood mechanism. Eley-Rideal mechanism Examples . surface heterogeneity. Catalysts preparations, structures and applications. Enzyme Catalysis. This course emphasizes theory and applications of catalysts in important organic and inorganic operations.

Chem 442 Physical Chemistry of Liquids, Solutions and collides: (2h lectures / weekly)
Pre-requisite: Chem 102

Pure Substances and Mixtures: Partial Molar Quantities and Molar Quantities. Explicit Expressions for Various Extensive Variables. Gibbs-Duhem Equation. Partial Molar Quantities. Measurement of Partial Molar Volumes. Thermodynamics of Gases: Pure Ideal Gas. Mixtures of Ideal Gases. Pure Real Gases. Mixtures of Real Gases. Ideal Mixtures of Gases. Thermodynamics of Perfect and Ideal Solutions.. Effect of Pressure and Temperature on Liquid Vapor Equilibria. Depression of the Freezing. Elevation of the Boiling Temperature of a Solvent in the Presence of a Non Volatile Solute. Osmotic Pressure. Non Ideal Solutions. Variables and Excess Variables of Mixing. Effect of Temperature and Pressure on the Activity Coefficient. Applications of the Gibbs–Duhem Equation. Isothermal Diagram. Isobaric Diagram. Standard State. Liquid – Liquid Extraction. Thermodynamic .Polar liquids: dielectric properties, water, structural properties of liquid water, non-aqueous polar liquids. Electrical conductance: The phenomena of electrolysis. Electrolysis Factors affecting the electrolysis. The Faraday constant: the Avogadro constant: their relationship. Industrial uses of electrolysis. conductance- Application- Electromotive force and Electrode potential. Cell reaction and E.M.F. Electrode potential - Electrochemical series.
Colloid chemistry: Colloidal state, classification of colloidal solution, true solution, colloidal solution and suspensions, preparation of sol, Purification of colloidal solutions, General properties and optical properties, stability of colloids, coagulation of lyphobic sols, electrical properties of sols, kinetic properties of colloids:- Brownion movement, Osmotic pressure, light scattering (Tyndall effect) and sedimentation methods for measuring particle size and particle weight are reviewed., emulsions, gels, colloidal electrolytes and applications of colloids.

Chem 443 Solid-State Chemistry: (2h lectures / weekly)
Pre-requisite: Chem 241

Topics include structural types and trends, including descriptive chemistry, crystal defects, nonstoichiometry, solid solutions, Crystal structure of solids: Fundamental Types of lattices, Simple crystal structure, Glasses, Crystal diffraction by X-rays, neutrons and electrons, Atomic form factor structure factor and Integrated intensity, Experimental diffraction methods,. Defects: Band theory of solid, Brilloin Zones; Metals: Electrical, thermal and magnetic properties, Semiconductors: Intrinsic and extrinsic, Junction properties, Transistors, rectifiers, solar cells. Ferroelectric, Piezoelectric and pyroelectric materials. Ferromagnetic and antiferromagnetic and ferrimagnetic materials and their properties.

Chem 444 Applied Electrochemistry and nuclear Chemistry: (2h lectures / weekly)
Pre-requisite: Chem 341

Electrochemistry: A discussion, with experimental demonstrations of electrochemical principles to the analysis of industrial processes. The behavior of concentrated salt solutions. Theoretical principles involved in plating, refining, winning; bright electrodeposition and powder deposition of metals; aqueous and fused salts, primary and secondary cells, and electrochemistry of gases. . The theory of electrochemical corrosion, corrosion tendency, rates, and passivity. Application to various environments. Cathodic protection and coatings. Corrosion testing.

Nuclear chemistry: Properties of nucleus- Stability of nucleus-Types of nuclear reactions- Types of radiations- Natural radioactivity and radioactive series- Theory of radioactive disintegration- Rate of radioactive decay- Mass and nuclear binding energy- Artificial radioactivity- Nuclear fission and fusion- Isotopes- Application of radiation chemistry.

Chem 445 Surface chemistry and Catalysis (1): (2h lectures / weekly)
Pre-requisite: Chem 241

Liquid interfaces, surface tension and surface free energy, measurement of surface and interfacial tension, spreading coefficient; adsorption at liquid interface, study of surfactants including applications like wetting foaming , solid-gas and solid-liquid interfaces, Liquid-gas interface and liquid-liquid interface. Measurement techniques for surface and interfacial tension are discussed. Wetting, detergency, the gas-solid and liquid-solid interfaces. Liquid interfaces: interfacial tension, adsorption at interfaces, surface active agents, adhesion and cohesion, wetting and contact angle, spreading, nucleation processes
Catalysis: This course focuses on homogeneous catalysis - Enzyme Catalysis – Acid base catalysis - heterogeneous catalysis- kinetics and mechanisms- absolute rates of surface reaction- surface heterogeneity.

Chem 446 Surface chemistry and Catalysis (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 241

Liquid interfaces, surface tension and surface free energy, measurement of surface and interfacial tension, spreading coefficient; adsorption at liquid interface, study of surfactants including applications like wetting foaming , solid-gas and solid-liquid interfaces, Liquid-gas interface and liquid-liquid interface. Measurement techniques for surface and interfacial tension are discussed. Wetting, detergency, the gas-solid and liquid-solid interfaces. Liquid interfaces: interfacial tension, adsorption at interfaces, surface active agents, adhesion and cohesion, wetting and contact angle, spreading, nucleation processes
Catalysis: This course focuses on homogeneous catalysis - Enzyme Catalysis – Acid base catalysis - heterogeneous catalysis- kinetics and mechanisms- absolute rates of surface reaction- surface heterogeneity.

BioChem 400: Research Project and Essay: (2h lecture weekly)

Reviewing a research project in biochemistry to be selected by the department, preparing a written essay on it.

BioChem 471 Advanced Molecular Biology: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 273

The concept of the gene, Units of genetic structure and genetic function, Gene-cistron relationship in prokaryotes and eukaryotes, Gene structure and architecture, Gene Expression and Regulation, Gene expression in prokaryotes and eukaryotes, Gene Transfer in Bacteria, Conjugation, Transformation, Transduction, Mutagenesis and DNA Repair, Mutagenesis and replication fidelity, DNA damage, DNA repair, Direct reversal repair, Excision repair, Mismatch repair, Recombination repair, The SOS response and mutagenic repair.

BioChem 472 Recent Trends in Biochemistry: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 273

Detection And Analysis of Proteins, Polyacrylamide gel electrophoresis, Isoelectric focusing, Two-dimensional gel electrophoresis, Western blot analysis, Chromatography, Gel filtration, Ion exchange, Chromatography, Affinity chromatography, High-performance liquid chromatography, Dialysis and ultrafiltration, Detection and Analysis Of Nucleic Acids, Basic methods for nucleic acid analysis, Gels and gradients for separation of nucleic acids, Agarose gel electrophoresis, Pulsed field electrophoresis, Alkaline agarose gels, Restriction enzymes and restriction fragments, Restriction fragment length polymorphism (RFLP), Single nucleotide polymorphisms, Southern blotting, Dot blotting and slot blotting, DNA sequencing, Maxam-Gilbert sequencing, Dideoxy or chain-termination sequencing, Automated DNA sequencing, Detection and quantitation of RNA, Northern blotting, Reverse transcriptase, Recombinant DNA Techniques, Cloning, and Manipulation Of DNA, Plasmid

and viral vectors, Plasmid Transformation, Bacteriophage, Bacteriophage vectors, M13 phage vectors, Phage display, Specialized vectors, Phagemids, Cosmids, Artificial chromosomes, Site Directed Mutagenesis, Oligonucleotide-directed mutagenesis, PCR-directed mutagenesis, Polymerase chain reaction, Introduction, Reverse transcription , Quantitative real-time PCR, Screening for differentially expressed genes, hybridization, Forensics and DNA technology, Flow cytometry and fluorescence activated cell, DNA content and cell cycle analysis.

BioChem 473 Metabolic Regulation: (2h lectures / weekly)
Pre-requisite: BioChem 276

The Underlying Principles of Human Metabolism, Cellular Mechanisms Involved in Metabolic Regulation, Digestion and Intestinal Absorption, Longer-Term Regulation of Metabolism, Integration of Carbohydrate, Fat, and Protein Metabolism in Normal Daily Life, Lipoprotein Metabolism, Diabetes Mellitus.

BioChem 474 Free radicals and antioxidants (2): (2h lectures + 3h practical/ weekly)
Pre-requisite: Chem 101

Inflammation, Age-Related Macular Degeneration (AMD(, Diabetes Mellitus, Respiratory Diseases, Cystic Fibrosis, Schizophrenia, Alzheimer's Disease, Cancer, Coronary Heart Disease, pregnancy, Ageing .

BioChem 475 Stem Cell Biology: (2h lectures / weekly)
Pre-requisite: Chem 101

Introduction: What are stem cells, and why are they important? , What are the unique properties of all stem cells? , What are embryonic stem cells? , What are adult stem cells? , What are the similarities and differences between embryonic and adult stem cells?, What are induced pluripotent stem cells? , What are the potential uses of human stem cells and the obstacles that must be overcome before these potential uses will be realized؟

BioChem 476 Cancer Biology: (2h lectures / weekly)
Pre-requisite: Chem 101

Causes of Cancer – nomenclature of cancer- classification of Cancer – DNA Damage/Repair Mechanisms -– Carcinogenesis and their mechanisms – Tumor Growth and angiogenesis - metastasis– Free Radicals and Cancer – The Cell Cycle - Oncogenes – Tumor suppressor genes – Cancer cell cycle and apoptosis – cancer cell metabolism – proteins coded by oncogene – signal transduction- Cancer prevention – Cancer treatment with different modalities – chemotherapy- immunotherapy- Gene therapy.

BioChem 477 Clinical Biochemistry: (2h lectures + 3h practical/ weekly)
Pre-requisite: BioChem 376

Basic principles of clinical Biochemistry: Collection of specimens – sources of variations in test results – Normal and reference ranges – assessment of diagnostic tests [sensitivity, specificity, accuracy, precisions, positive predictive value (PPV), negative predictive value (NPV)..etc] - Disorders of moiety metals and non-metals as well as trace metals and trace non-metals - Abnormalities of plasma proteins - Use of plasma enzymes in diagnosis – Renal and liver diseases – Gastrointestinal tract diseases – Disorders of carbohydrate , fats, purine and porphyrin metabolism – Abnormalities of thyroid, adrenal cortex, adrenal medulla, hypothalamus and pituitary functions – Molecular biology in clinical Biochemistry.

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Botany Department

First Level

B 101 Plant Morphology & Anatomy: (2h lecture, 2h practical & 1h tutorial/weekly)

Plant morphology: Seed structure and germination - Typical plant architecture - Morphology of plant organs (Root, Stem & leaf) - Modifications of plant organs.
Plant anatomy: Plant cell structure and cell wall types - Types of plant tissues - Anatomy of primary plant organs (Root, Stem & leaf).

B 102 Biodiversity & Principals of Plant Physiology: (2h lecture, 2h practical & 1h tutorial/weekly)

Biodiversity: Classification systems of living organisms - Characteristic features of kingdoms & representative genera: Kingdom: Monera, Kingdom: Fungi, Kingdom: Protista, Kingdom: Planta
Plant physiology: Cytoplasm and its physical & chemical properties - Osmosis and permeability - Studies on physiological interaction between: plants & soil – Enzymes - Respiration & Photosynthesis.

B106 Physiology & Microbiology: (2h lecture and 2h practical /weekly)

Plant physiology: Cytoplasm and its physical & chemical properties **-** Osmosis and permeability - Studies on physiological interaction between: plants & soil – Enzymes - Respiration & Photosynthesis
Microbiology - Microbial diversity - Prokaryotes (Bacteria & Archaea): Cell Envelopes, Cell Walls, Cell Components, External Structures **-** Eukaryotic cell structure (fungi) **-** Isolation & cultivation of microorganisms **-** Environmental factors affecting microbial growth **-** Modes of nutrition in microorganisms **-** Control of microbial growth **-** Microbial interactions & biogeochemical cycles in the environment.

Second Level

B 201 Plant Cell Ultrastructure & Genetics: (2h lecture, 2h practical & 1h tutorial/weekly)

Plant Cell ultrastructure: Timeline of membrane structure and microscopy techniques - Cell cycle - Ultrastructure of the cell membranes - Ultrastructure of nucleus.
Genetics: Genetic terminology - Chromosome theory - Mendelian inheritance - Non-Mendelian inheritance - Cytoplasmic inheritance

B 202 General Plant Metabolism: (2h lecture, 2h practical & 1h tutorial/weekly)

Anabolism & catabolism definitions - Carbohydrate metabolism - Outline of Lipid metabolism -Outline of Amino acid metabolism & organic acid metabolism.

B 203 Introduction in Plant Ecology & Plant Taxonomy (1) (2h lecture, 2h practical & 1h tutorial/weekly)

Plant ecology: Definition of plant ecology - The vegetation and its evolution – Concepts of plant succession - Classification of plant according to their water - Definition of soil – Origin, formation and characteristics of soil
Plant taxonomy: Basic structure & types of flowers - Inflorescence & fruits - Pollination & plant fertilization - Study of concise families of the monocots & dicots

B 204 Phycology and Physiology of Plant Growth & development: (2h lecture, 2h practical & 1h tutorial/weekly)
Phycology: General characteristics of algae, types, morphology & structure - Algal ecology - Classification of algae – characteristic features - Reproduction & life cycles with special examples of some selected algal species - Economic significance of some algal species
Plant Physiology & Development: Seed germination and dormancy- Factors affecting germination - Growth: definitions and growth curves – factors affecting plant growth - Normal and stress conditions for plant growth - Physiology of flowering, fruiting and yield - Development and differentiation of plants, ontogenesis - Integrity of plants and correlation of growth.

B 205- General Microbiology (1h lecture & 2h practical/weekly)

Microbial diversity - Prokaryotes (Bacteria & Archaea): Cell Envelopes, Cell Walls, Cell Components, External Structures - Eukaryotic cell structure (fungi) - Isolation & cultivation of microorganisms - Environmental factors affecting microbial growth - Modes of nutrition in microorganisms - Control of microbial growth - Microbial interactions & biogeochemical cycles in the environment

B 206 Biophysics of Photosynthesis: (2h lecture and 2h practical /weekly)
Universal features of the cell particularly energy metabolism - The organization of the cell- The differences between eukaryotes and prokaryotes - Oxygenic and anoxygenic photosynthetic organisms - The energetically favrouble and unfavrouble reactions - Activated carrier molecules - The chemi-osmotic coupling -The photosynthetic pigments - What is light - Photosynthesis, PHOTOSYSTEM, LIGHT DEPENDENT AND INDEPENDENT REACTIONS - Non-cyclic and cyclic photophosphorylation.

M 201 Introduction of Plant Cell Ultrastructure & Genetics: (2h lecture, 2h practical & 1h tutorial/weekly)
Plant Cell ultrastructure: Timeline of membrane structure and microscopy techniques - Cell cycle - Ultrastructure of the cell membranes - Ultrastructure of nucleus.
Genetics: Genetic terminology - Chromosome theory - Mendelian inheritance - Non-Mendelian inheritance - Cytoplasmic inheritance

M 202 Introduction in Plant Metabolism: (2h lecture, 2h practical & 1h tutorial/weekly)

Anabolism & catabolism definitions - Carbohydrate metabolism - Outline of Lipid metabolism - Outline of Amino acid metabolism & organic acid metabolism

M203 – Introduction in Phycology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 102

General characteristics of algae, types, morphology & structure – Different habitats of algae - Classification of algae – characteristic features - Reproduction & life cycles with special examples of some selected algal species - Economic significance of some algal species.

M 204 Principals of Plant Ecology & Plant Taxonomy: (2h lecture, 2h practical & 1h tutorial/weekly)
Plant ecology: Definition of plant ecology - The vegetation and its evolution – Concepts of plant succession - Classification of plant according to their water - Definition of soil – Origin, formation and characteristics of soil.
Plant taxonomy: Basic structure & types of flowers - Inflorescence & fruits - Pollination & plant fertilization - Study of concise families of the monocots & dicots.

M 205 Growth Regulators and Physiology of Plant Growth & development: (2h lecture, 2h practical & 1h tutorial/weekly)

Growth Regulators: Definitions, chemical & biophysical properties of plant hormones - Classification & mode of action of hormones - Main metabolic processes of phyto-hormones - Main groups of plant hormones (auxin- gibberellins- cytokinins- abscisic- ethylene).
Plant Physiology & Development: Seed germination and dormancy- Factors affecting germination - Growth: definitions and growth curves – factors affecting plant growth - Normal and stress conditions for plant growth - Physiology of flowering, fruiting and yield - Development and differentiation of plants, ontogenesis - Integrity of plants and correlation of growth

M 206 Phycology and Principals of Physiology of Plant Growth & development: (2h lecture, 2h practical & 1h tutorial/weekly)

Phycology: General characteristics of algae, types, morphology & structure - Algal ecology - Classification of algae – characteristic features - Reproduction & life cycles with special examples of some selected algal species - Economic significance of some algal species.
Plant Physiology & Development: Seed germination and dormancy- Factors affecting germination - Growth: definitions and growth curves – factors affecting plant growth - Normal and stress conditions for plant growth - Physiology of flowering, fruiting and yield - Development and differentiation of plants, ontogenesis - Integrity of plants and correlation of growth.

M 207 Principals of General Microbiology: (2h lecture, 2h practical & 1h tutorial/weekly)

Microbial diversity - Prokaryotes (Bacteria & Archaea): Cell Envelopes, Cell Walls, Cell Components, External Structures - Eukaryotic cell structure (fungi) - Isolation & cultivation of microorganisms - Environmental factors affecting microbial growth - Modes of nutrition in microorganisms - Control of microbial growth - Microbial interactions & biogeochemical cycles in the environment.

Third Level

B 301 Bacteriology: (1h lecture, 2h practical & 1h tutorial/weekly)

Bacteriology: Morphology & structure of bacterial cell - Systems of classification of bacteria - Reproduction - Growth assessment -Environmental factors affecting growth - Aerobic & anaerobic respiration and fermentation metabolism - Bacterial ecology & it's environmental impacts - Bacterial pathogens..

B 302 Cytogenetics & Molecular Genetics: (2h lecture & 2h practical/weekly)

Cytogenetics: Chromosomal Karyotype - Bending of chromosome - Cell divisions -Mitotic chromosomal abnormalities Numerical chromosomal abnormalities - Structural chromosomal abnormalities - Mutagenicity & mutagenic agents
Molecular Genetics: DNA mutations - DNA damage & repair - Genetic markers - Reporters genes - PCR types & applications - Quantification of gene expression - DNA sequencing

B 303 Physiology of Algae & Ecology of Algae: (2h lecture & 2h practical)
Pre-requisite B 102

Physiology of Algae: Algal Growth (micro- & macro-algae) - isolation, cultivation - Environmental factors affecting algal growth: nutrients, light, pH, temperature - Algal nutrition - Metabolism: anabolism & catabolism - Physiological adaptation mechanisms to environmental stresses: water stress, oxidative stress, environmental pollution
Algal Ecology: Algal ecology: distribution of algae in the various ecosystems - Role of algae in the geochemical cycles of elements in nature: carbon, nitrogen, phosphorus, oxygen -Principals of algal chemical ecology.

B 304 Mycology: (2h lecture, 2h practical & 1h tutorial/weekly)

Biology of the true fungi & nutrition - Taxonomy of fungi - Different fungal classes & representative genera (type of reproduction**, characteristics**, origin of spores) - Fungal ecology (marine & soil fungi) - Economic significance of fungi.

B 305 Bio-fertilizers & Soil Reclamation: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 101

Biofertilizers: Types biofertilizers & classification - Significant microorganisms in biofertilization - Algae (micro- & macroalgae), Yeast, Mycorrhiza - Strategies of biofertilizers for sustainable soil fertility - Production of biofertilizers - Biofertilizer-plant interaction & its role in plant growth & development
Soil reclamation: Contamination of soil & anthropogenic drawbacks – Salinization - Lowering of organic load - Contamination with heavy metals High alkalinity - Lowering of water holding capacity.

B 306 Advanced Plant Anatomy & Comparative Morphology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 101

Plant anatomy: Introduction - Cells, tissues and organs - Anatomy of stem, root and leaf - Secondary thickening - Abnormal secondary thickening - Effects of environment on plant anatomy
Comparative morphology: Introduction - Classification - Bryophyta – Pteridophyta - Pteridospermae with selected groups and species.

B 307 Plant Growth Regulators: (2h lecture, 2h practical & 1h tutorial/weekly)

Definitions, chemical & biophysical properties of plant hormones - Classification & mode of action of hormones - Main metabolic processes of phyto-hormones - Main groups of plant hormones (auxin-gibberellins- cytokinins- abscisic- ethylene) - Hormonal correlations - Other growth regulators.

B 308 Climate and Plant geography & taxonomy (2): (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 203

Climate: Definition of climate and weather - General importance and components of climatic factors - Precipitation, temperature, Light and radiation, Humidity, Wind, Evaporation, Atmospheric gases.
Plant geography: Definition - Ultimate purpose of phytogeography, Dispersal, Barriers - Types of plant distribution, Endemisas, Relic areas, Habitat types, Latitudinal and Altitudinal distribution of plants. Flora of Egypt , ecological characteristics of Egypt, Historical notes on the flora of Egypt - Western desert and its flora, The Sinai peninsula and its flora - The Nile region and its flora, Pharaonic plants, Drug plants.
Plant taxonomy(2): Scientific systems for taxonomy of flowering plants - Studies of 10 orders of class I (Monocotyledoneae) - Studies of 14 orders of class II (Dicotyledoneae): Monochlamdeae 6 orders including 10 families, Dialypetalae 8 orders including 65 families. Plant cover, Definition, Vegetation and its revolution, Plant succession: hydroses and xerosere, Classification of plants according to their water, Factors affecting vegetation.

B 309 Mineral nutrition and water- relationships: (2h lecture, 2h practical & 1h tutorial/weekly)

Mineral nutrition: Definition of mineral nutrition - Sources of mineral salts in nature - Diagnostic techniques for nutritional requirements - Salt requirements for plant - Ion uptake by plants - Availability of mineral salts, function & deficiency symptoms - Mechanism of salt absorption - Transport across root - Factors affecting absorption of mineral salts - Translocation & circulation of minerals in the plant
Water relationships: Importance of water in plant life - Structure of water and properties important to plants - Water potential and relationship of osmotic quantities - Mechanism of water absorption and factors affecting absorption and path of water movement through root -Translocation of water - Water loss from plants(guttation, transpiration, and measurement of transpiration - Mechanism of opening and closing of stomata and factors affecting it and factors affecting transpiration **-** Drought stress and its effects on plant growth and metabolism

B 310 Plant Pathology: (2h lecture & 2h practical /weekly)
Pre-requisite B 102

Introduction & general terminology - Diagnosis of plant diseases - Biotic causal agents of plant diseases: fungi, bacteria, viruses, nematodes - Syptomology - Disease cycle & epidemiology - Plant disease control.

B 311 Physiology of Microorganisms: (2h lecture, 2h practical & 1h tutorial/weekly)

Structure & function - Chemical composition of cell & reserve materials - Microbial nutrition: Trophic microbial classes & mechanisms of nutrient capturing - Microbial growth: Environmental factors affecting growth - Growth mechanisms (apical growth in filamentous fungi) & kinetics - Mechanisms of control - Microbial Nutrition: Strategies of nutrient capturing - Microbial metabolism: (Cellular Energy Derived from Chemicals, Cellular Energy Derived from Light, Metabolism of inorganic nutrients & their biochemical role, Biosynthesis of Monomers, Assembly of microbial Cell Structures, Role of Microbes in Biodegradation in nature.

B 312 Photobiology & Plant Growth Regulators: (2h lecture, 2h practical & 1h tutorial/weekly)

Photobiology: Introduction to the study of photobiology - Phytochrome concept - Mode of phytochrome action, Phytochrome activities - Phototropism, Distribution and transformation of phytochrome in plants - Effects of visible light on plant development - Effects of light on the formation of anthocyanine and other flavonoid compounds - Effects of ultraviolet light (UV) photoreactivation, Ultraviolet damage.
Plant growth regulators: Definitions, chemical & biophysical properties of plant hormones - Classification & mode of action of hormones - Main metabolic processes of phyto-hormones- Main groups of plant hormones (auxin- gibberellins- cytokinins- abscisic- ethylene).

B 313 Cytogenetic & Microbial Genetics: (2h lecture & 1h tutorial/weekly)

Cytogenetics: Chromosomal Karyotype - Bending of chromosome - Cell divisions - Mitotic chromosomal abnormalities - Numerical chromosomal abnormalities - Structural chromosomal abnormalities - Mutagenicity & mutagenic agents.
Microbial genetics: Bacterial genome and plasmid - Microbial replication, transcription and translation - Microbial gene organization and operon structure - Gene transfer in bacteria.

B 314 Bacteriology & Virology: (2h lecture, 2h practical & 1h tutorial/weekly)

Bacteriology: Morphology & structure of bacterial cell - Systems of classification of bacteria - Reproduction - Growth assessment - Environmental factors affecting growth - Aerobic & anaerobic respiration and fermentation metabolism - Bacterial ecology & it's environmental impacts - Bacterial pathogens.
Virology: Historical introduction, scientific investigation and discovery of virus - Nature of viruses - Isolation and purification of Viruses and classification of viruses - Criteria of purity / Maintenance and Preservation, pathogenicity and control of viral infection - Cultivation of viruses in organized tissue - Cultivation of viruses in tissue culture /Laboratory viral reservoirs- Processes of infection in Plant and animal viruses - Biochemistry of viruses/ chemical composition - Morphology, architecture, Secondary and higher structure - Bacteriophage, Discovery and properties - Virus transmission and control of virus infection.

B 315 Stress Physiology & Biocontrol: (2h lecture, 2h practical & 1h tutorial/weekly)

Introduction to the study of stress physiology - Types of stress - Water stress: salinity, Osmotic, moisture, drought, water logging - Temperature stress - Light stress - Chemical stress - Physiological effects of stress on germination of seeds, growth of plants, development - Methods of partly or completely nullification the harmful effects of stress - Antioxidants and stress physiology.

B 316 Bioinformatics & Applications: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 201

Genome variations - Molecular biology data basis - Genetic markers - Phylogenetic analysis - DNA mapping - DNA sequencing & data analysis – Applications.

M 301 Biology of Bacteria: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite M 207

Morphology & structure of bacterial cell - Systems of classification of bacteria – Reproduction - Growth assessment - Environmental factors affecting growth - Aerobic & anaerobic respiration and fermentation metabolism - Bacterial ecology & it's environmental impacts - Bacterial pathogens.

M 302 Microbial Genetics & Plant Growth Regulators: (2h lecture, 1h tutorial/weekly)
Pre-requisite M 201

Microbial genetics: Bacterial genome and plasmid - Microbial replication, transcription and translation - Microbial gene organization and operon structure - Gene transfer in bacteria.
Plant growth regulators: Definitions, chemical & biophysical properties of plant hormones - Classification & mode of action of hormones - Main metabolic processes of phyto-hormones - Main groups of plant hormones (auxin- gibberellins- cytokinins- abscisic- ethylene).

M 303 Microbial Genetics & Genetic Control: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 201

Microbial genetics: Bacterial genome and plasmid - Microbial replication, transcription and translation - Microbial gene organization and operon structure - Gene transfer in bacteria
Genetic control: Types of gene regulation - Levels of gene regulation - Gene control in prokaryotes - Gene control in eukaryotes - Control of cell cycle.

M 304 Production of Bio-fertilizers & Soil Reclamation: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 102

Production of Bio-fertilizers: Types biofertilizers & classification - Significant microorganisms in biofertilization - Production of bacterial, fungal & Yeast, Mycorrhiza - Strategies of biofertilizers for sustainable soil fertility - Production of seaweeds liquid fertilizers biofertilizers - Biofertilizer-plant interaction & its role in plant growth & development.
Soil reclamation: Contamination of soil & anthropogenic drawbacks – Salinization - Lowering of organic load - Contamination with heavy metals - High alkalinity - Lowering of water holding capacity.

M 305 Principles of Enzymology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite M 202

Reaction kinetics of simple & complex reactions:Thermodynamic aspects of reactions: - Enzyme kinetics: - Reaction catalytic mechanisms - Structure/function relationships - Catalytic nucleic acids - Microbial inducible enzymes.

M 306 Food Microbiology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite M 207

Classification / Taxonomy of food-borne microorganisms - Normal microbiological quality of foods & its significance - Microbial growth responses in food environment - Microbial food spoilage - Microbial metabolism of food components - Food biotechnology - fermented foods - Food preservation strategies - Food biosafety.

M 307 Introduction to Medical Microbiology & Microbial Toxins: (2h lecture & 1h tutorial/weekly)

Medical Microbiology: Microbial pathogenesis and the host response, and the scientific approaches that are used to investigate these processes - Adherence of microbes to host cells - Mechanisms of bacterial pathogenesis - Pathogenicity & virulence factors - Antibiotics & chemotherapeutics - Microbial pathogens diagnosis.

Microbial Toxins: diversity, occurrence, mechanisms of action, bioavailability, acute & chronic toxicity - detection methods of microbial toxins (mycotoxins, bacterial, algal toxins).

M 308 Principals of Virology & Immunology: (2h lecture & 2h practical/weekly)

Virology: Historical introduction, scientific investigation and discovery of virus - -Nature of viruses - Isolation and purification of Viruses and classification of viruses - Criteria of purity / Maintenance and Preservation, pathogenicity and control of viral infection - Cultivation of viruses in organized tissue - Cultivation of viruses in tissue culture /Laboratory viral reservoirs - Processes of infection in Plant and animal viruses - Biochemistry of viruses/ chemical composition - Morphology, architecture, Secondary and higher structure - Bacteriophage, Discovery and properties - Virus transmission and control of virus infection.
Immunology: Historical background - Innate immunity – Antigens - Acquired immunity - Interaction of antibody with antigen and applied in laboratory investigation (Serological tests).

M 309 Fungal Biology: (2h lecture, 2h practical & 1h tutorial/weekly)

Biology of the true fungi & nutrition-Modern classification of fungi - Taxonomy of fungi - Different fungal classes & representative genera - type of reproduction (characteristics- origin of spores) - Fungal ecology (marine & soil fungi) - Economic significance of fungi.

M 310 Plant Mineral Nutrition & Fermentations: (2h lecture, 2h practical & 1h tutorial/weekly)

Mineral nutrition: Definition of mineral nutrition- Sources of mineral salts in nature - Diagnostic techniques for nutritional requirements - Salt requirements for plant - Ion uptake by plants - Availability of mineral salts, function & deficiency symptoms - Mechanism of salt absorption - Transport across root - Factors affecting absorption of mineral salts - Translocation & circulation of minerals in the plant
Fermentations: Scope; microorganisms commonly used in industry - Fermentation technology: Batch Fermentation, Continuous Fermentation, Fed-Batch Fermentation, upstream & downstream processes - Components in a Typical Bioreactor (Media & nutritional requirements of industrial microorganisms) - Types of Submerged Bioreactors - Microbial growth kinetics & substrate growth relationship - Solid Substrate Fermentation, types of solid substrate bioreactors - Production of single cell proteins, biocatalysts; microbial metabolites: organic acids, amino acids & antibiotics.

M 311 Soil Microbiology: (2h lecture & 2h practical /weekly)

Characteristics of soil environment - Diversity of microorganisms of soil - Biogeochemical cycles & mineral transformation by microorganisms - Interactions between microorganisms - Biodegradation of soil contaminants.

M 312 Environmental Microbiology: (2h lecture & 2h practical/weekly)

The influence of abiotic & biotic factors on the activity of microorganism:- -abiotic factors (temperature, water, oxygen, pH, radiation) - biotic factors (interactions between organisms & plants, microorganism & plants) - anthropogenic factors - Microflora of basic components of the environment- -Microbiology of aquatic ecosystems & air - Soil microbiology - The role of microorganisms in the cycles of carbon, nitrogen, phosphorus & sulfur in nature - Ecological & economic importance of microorganisms.

M 313 Principals of Plant Biochemistry: (2h lecture & 2h practical/weekly)

Introduction to biochemistry; water, pH, buffers, - carbohydrates – structure, classification & metabolism - proteins - composition & structure & nitrogen metabolism - lipids - structure, classification & metabolism - enzymes - properties, nomenclature, classification, & secondary metabolites - coenzymes and vitamins; nucleic acids - structure & function.

M 314 Introduction in Applied Microbiology: (2h lecture & 2h practical/weekly)

Microbial bioremediation of organic and inorganic pollutants (dyes, heavy metals) - Microbial biodegradation of xenobiotic compounds - Bio-mining - Production of secondary metabolites - Production of bio-plastic from bacteria & cyanobacteria - Agricultural Applications of Microbes Bio-pesticides - Microbes in the food industry – fermented foods - Microbial enzymes - immobilization & industrial applications.

Fourth Level

B 400 Research Project: (2h lecture /weekly)
Introduction of the selected subject - Identifying a research problem & designing a study - Extraction and review of literature - Data collection, interpretation and analysis - Unethical academic practices (plagiarism) - Writing a research report, project - Preparing posters & oral presentations.

B 401 Research Project: (1h lecture /weekly)
Introduction of the selected subject - Identifying a research problem & designing a study - Extraction and review of literature - Data collection, interpretation and analysis - Unethical academic practices (plagiarism) - Writing a research report, project - Preparing posters & oral presentations.

B 402 Biotechnology: (1h lecture, 2h practical & 1h tutorial/weekly)

Definition and history and related sciences of biotechnology - Role of microorganisms in genetic engineering - Application of genetically modified microorganisms; in pharmacy, Bt crops, biofuels & food production - Bioreactors & their application - Plant-microbes interactions - Safety & ethics.

B 403 Ecosystem & Pollution (2h lecture, 2h practical & 1h tutorial/weekly)

Ecosystem: Integrated levels in ecology - Components of the ecosystem - Trophic levels in the ecosystem - The major ecosystems of the world - Egypt and its main ecosystems.
Pollution: Environmental pollution concepts and types - Air pollution and its impacts - Water pollution and its impacts - Soil pollution.

B 404 Principals of Virology & Immunology: (2h lecture, 2h practical /weekly)

Virology: Historical introduction, scientific investigation and discovery of virus - Nature of viruses - Isolation and purification of Viruses and classification of viruses - Criteria of purity / Maintenance and Preservation, pathogenicity and control of viral infection - Cultivation of viruses in tissue culture /Laboratory viral reservoirs - Processes of infection in Plant and animal viruses - Biochemistry of viruses/ chemical composition - Morphology, architecture, Secondary and higher structure - Bacteriophage, Discovery and properties - Virus transmission and control of virus infection.
Immunology: Historical background - Innate immunity – Antigens - Acquired immunity - Interaction of antibody with antigen and applied in laboratory investigation (Serological tests).

B 405 Plant Biochemistry: (2h lecture, 2h practical & 1h tutorial/weekly)

Introduction to biochemistry; water, pH, buffers - Carbohydrates – structure, classification & metabolism - Proteins - composition & structure & nitrogen metabolism - Lipids - structure, classification & metabolism - Enzymes - properties, nomenclature, classification, & secondary metabolites - Coenzymes and vitamins; nucleic acids - structure & function.

B 406 Soil Microbiology & Host Parasite Relationship: (2h lecture &2h practical /weekly)

Soil Microbiology: Characteristics of soil environment - Diversity of microorganisms of soil - Biogeochemical cycles & mineral transformation by microorganisms - Interactions between microorganisms - Biodegradation of soil contaminants.
Host-Parasite Relationship: Types of Symbiosis & Parasitism - Attack mechanisms of plant by pathogens: enzymes, toxins, hormones, polysaccharides - Host defenses against parasites & parasites adaptations: structural, chemical & molecular.

B 407 Plant Secondary Metabolism & Microbial Genetics (2h lecture, 2h practical /weekly)

Plant Secondary Metabolism: Definition – Terpenoids – Alkaloids - Phenols
Microbial genetics: Bacterial genome and plasmid - Microbial replication, transcription and translation - Microbial gene organization and operon structure - Gene transfer in bacteria.

B 408 Nutrient cultures and Plant tissue culture: (2h lecture, 2h practical & 1h tutorial/weekly)

Nutrient cultures: Types and composition of nutrient cultures - Nutrient cultures for growth of microorganisms - Nutrient cultures for growth of higher plants - Specifications and factors affecting nutrient cultures.
Plant tissue culture: Isolation of plant tissues for transplanting - Bioassay systems for cytokinins - Plant propagation: Sexual and vegetative propagation - Morphogenesis in vitro: Studies on regeneration, Isolation, Culture and fusion of protoplasts from higher plants, Embryo and organ culture, Callus formation, Transplantation.

B 409 Plant Community and flora of Egypt: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 203

Plant Community: General definition, units of vegetation - Field studies of vegetation; Analytic characteristics of community - Synthetic characteristics of community.
Flora of Egypt: Ecological characteristics of Egypt - Historical notes on the flora of Egypt - Western desert and its flora - Sinai peninsula and its flora - The Nile region and its flora - Pharaonic plants - Drug plants.

B 410 Stress Physiology: (2h lecture, 2h practical & 1h tutorial/weekly)

Introduction to the study of stress physiology - Types of stress - Water stress: salinity, Osmotic, moisture, drought, water logging - Temperature stress - Light stress - Chemical stress - Physiological effects of stress on germination of seeds, growth of plants, development - Methods of partly or completely nullification the harmful effects of stress - Antioxidants and stress physiology

B 411 Molecular Biology: (2h lecture, 2h practical & 1h tutorial/weekly)

Structure of DNA - DNA packaging in prokaryotes & eukaryotes - DNA replication in prokaryotes & eukaryotes - Gene structure in prokaryotes & eukaryotes - Gene expression in prokaryotes & eukaryotes - DNA modifying enzymes - Cloning of DNA;

B 412 Nutrient cultures and Principals of Plant tissue culture: (1h lecture, 2h practical & 1h tutorial/weekly)
Nutrient cultures: Types and composition of nutrient cultures - Nutrient cultures for growth of microorganisms - Nutrient cultures for growth of higher plants - Specifications and factors affecting nutrient cultures.
Plant tissue culture: Isolation of plant material and studies on growth and cell division - Bioassay systems for cytokinins, Plant propagation: Sexual and vegetative propagation - Morphogenesis in vitro: Studies on regeneration, Isolation, Culture and fusion of protoplasts from higher plants - Embryo and organ culture, Callus formation, Transplantation.

B 413 Enzymology: (2h lecture, 2h practical & 1h tutorial/weekly)

Reaction kinetics of simple & complex reactions: Thermodynamic aspects of reactions (Enzyme kinetics: Reaction catalytic mechanisms: - Structure/function relationships - Catalytic nucleic acids - Enzyme Specificity.

B 414 Mycology & Plant Pathology: (2h lecture, 2h practical & 1h tutorial/weekly)

Mycology: Biology of the true fungi & nutrition - Taxonomy of fungi - Different fungal classes & representative genera - type of reproduction - characteristics - origin of spores - Fungal ecology (marine & soil fungi) - Economic importance of fungi.
Plant Pathology: Introduction & general terminology - Diagnosis of plant diseases - Biotic causal agents of plant diseases: fungi, bacteria, viruses, nematodes – Syptomology - Disease cycle & epidemiology - Plant disease control.

B 415 Economic Botany & Molecular Genetics: (2h lecture, 2h practical & 1h tutorial/weekly)

Economic Botany: Classification of economic plants - Classification of plant active components - Energy yielding plants (starch & sugar) - Oil & waxes yielding plants - Fiber plants - Medicinal plants - Economic importance of microorganisms.
Molecular Genetics: DNA mutations - DNA damage & repair - Genetic markers - Reporters genes - PCR types & applications - Quantification of gene expression - DNA sequencing.

M 400 Research Project: (2h lecture/weekly)
Introduction of the selected subject- -Identifying a research problem & designing a study - Extraction and review of literature - Data collection, interpretation and analysis - Unethical academic practices (plagiarism) - Writing a research report, project - Preparing posters & oral presentations.

M 401 Research Project: (1h lecture/weekly)
Introduction of the selected subject - Identifying a research problem & designing a study - Extraction and review of literature - Data collection, interpretation and analysis - Unethical academic practices (plagiarism) - Writing a research report, project - Preparing posters & oral presentations.

M 402 Plant Pathology & Host-Parasite Relationship: (2h lecture, 2h practical & 1h tutorial/weekly)

Plant Pathology: Introduction & general terminology - Diagnosis of plant diseases - Biotic causal agents of plant diseases: fungi, bacteria, viruses, nematodes – Syptomology - Disease cycle & epidemiology - Plant disease control.
Host-Parasite Relationship: Types of Symbiosis & Parasitism - Attack mechanisms of plant by pathogens: enzymes, toxins, hormones, polysaccharides - Host defenses against parasites & parasites adaptations: structural, chemical & molecular

M 403 Principals of Molecular Biology: (2h lecture, 2h practical & 1h tutorial/weekly)

Structure of DNA - DNA packaging in prokaryotes & eukaryotes - DNA replication in prokaryotes & eukaryotes - Gene structure in prokaryotes & eukaryotes - Gene expression in prokaryotes & eukaryotes - DNA modifying enzymes - Cloning of DNA – Applications.

M 404 Applied & Industrial Microbiology: (2h lecture, 2h practical & 1h tutorial/weekly)

Microbial bioremediation of organic and inorganic pollutants (dyes, heavy metals) - Microbial biodegradation of xenobiotic compounds - Bio-mining - Production of bio-plastic from bacteria & cyanobacteria - Agricultural Applications of Microbes – Bio-pesticides - Microbes in the food industry – fermented foods - Microbial enzymes - immobilization & industrial applications - Industrial microbiology.

M 405 Principles of Physiology of Algae & Algal Ecology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite B 204

Physiology of Algae: Algal Growth (micro- & macro-algae)- isolation, cultivation - Environmental factors affecting algal growth: nutrients, light, pH, temperature - Algal nutrition - Metabolism:

anabolism & catabolism - Physiological adaptation mechanisms to environmental stresses: water stress, oxidative stress, environmental pollution.
Algal Ecology: Algal ecology: distribution of algae in the various ecosystems - Role of algae in the geochemical cycles of elements in nature: carbon, nitrogen, phosphorus, oxygen.

M 406 Cytogenetics & Advanced Molecular Genetics: (2h lecture, 2h practical & 1h tutorial/weekly)
Cytogenetics: Chromosomal Karyotype **-** Bending of chromosome - Cell divisions - Mitotic chromosomal abnormalities - Numerical chromosomal abnormalities - Structural chromosomal abnormalities - Mutagenicity & mutagenic agents.
Molecular Genetics: DNA mutations - DNA damage & repair- Genetic markers- Reporters genes - PCR types & applications - Quantification of gene expression - DNA sequencing - Applications.

M 407 Applied Microbiology: (2h lecture, 2h practical & 1h tutorial/weekly)
Pre-requisite M 207

Microbial bioremediation of organic and inorganic pollutants (dyes, heavy metals) - Microbial biodegradation of xenobiotic compounds - Bio-mining - Production of secondary metabolites - Production of bio-plastic from bacteria & cyanobacteria - Agricultural Applications of Microbes Bio-pesticides - Microbes in the food industry – fermented foods - Microbial enzymes - immobilization & industrial applications

M 408 Advanced Physiology of Microorganisms: (2h lecture, 2h practical & 1h tutorial/weekly)

Structure & function - Chemical composition of cell & reserve materials - Microbial nutrition: Trophic microbial classes & mechanisms of nutrient capturing - Microbial growth: Environmental factors affecting growth - Growth mechanisms (apical growth in filamentous fungi) & kinetics - Mechanisms of control - Microbial Nutrition: Strategies of nutrient capturing - Microbial metabolism: (Cellular Energy Derived from Chemicals, Cellular Energy Derived from Light, Metabolism of inorganic nutrients & their biochemical role, Biosynthesis of Monomers, Assembly of microbial Cell Structures, Role of Microbes in Biodegradation in nature.

M 409 Microbial Natural Products: (2h lecture, 2h practical & 1h tutorial/weekly)

Bioactive compounds from microorganisms (algae, bacteria & fungi) - Outline of metabolic pathways of the secondary metabolites - Methods for extraction, isolation, molecular separation & purification of biomolecules from natural sources. - Bioassay-directed fractionation of natural products.

M 410 Instruments & Microbial Techniques: (2h lecture, 2h practical & 1h tutorial/weekly)

Instruments: Spectrophotometric analyses - HPLC, PCR, Gel Electrophoresis, and microarrays gel documentation systems, DNA sequencers.
Microbial techniques: Principle & structure of Biological Assay - Advantages & disadvantages of bioassays - Types of Bioassays - Antimicrobial Assays - Proteins and their purification by affinity chromatography; polymerase chain reaction (PCR) – types & its applications - Analysis of nucleic acids by gel electrophoresis - Analysis of proteins by SDS-PAGE.

M 411 Bioinformatics & Biosafety: (2h lecture & 1h tutorial/weekly)
Pre-requisite M 201

Bioinformatics: Genome variations - Molecular biology data basis - Genetic markers - Phylogenetic analysis - DNA mapping - DNA sequencing & data analysis.
Biosafety: Genetic modified organisms (GMO) - Control of gene transfer - Hazards of nuclear transformation - Benefits of cytoplasmic transformation - Biosafety guidelines.

M 412 Advanced Mycology: (2h lecture, 2h practical & 1h tutorial/weekly)

Biology of the true fungi & nutrition - Taxonomy of fungi - Different fungal classes & representative genera - type of reproduction – characteristics: origin of spores, Fungal ecology (marine & soil fungi), Economic significance of fungi.

Zoology Department

First Level

Z101 Introduction of Cytology, Histology & Genetics: (2h lectures and 2h practical/Weekly)

Cell components and ultrastructure- cell division (mitosis and meiosis)- epithelial tissues- connective tissues- vascular tissues- muscular tissues- nervous tissues- basic molecular biology- genetic engineering techniques- DNA modifying enzymes- the biology of genetic engineering.

Z102 Principles of Animal Taxonomy: (2h lectures and 2h practical/Weekly)

Introduction to Taxonomy. Principles of Animal Taxonomy. History of Taxonomy.
Scientific Classification of Organisms (Basic Characters of Classification), Biological Nomenclature & concepts of Species. Division of Living Organisms: Kingdom: Planta, kingdom: Protista & Kingdom: Animalia. Subdivisions (Phylum, Class, Order, Family, Genus, Species). Classification Scheme. Kingdom: Protista (Protozoa). Classification, Basic Characters. Examples of Protozoan Animals*: Amoeba, Entamoeba, Euglena, Trypanosoma, Leishmania, Giardia, Toxoplasma, Plasmodium, Cryptosporidium, Paramecium, Balantidium, Trichomonus*. Broad classification of animal kingdom: Mesozoa, Parazoa and Eumetazoa (Radiata, Bilateria); Protostomia (Acoelomata, Pseudocoelomata and Eucoelomata), Deuterostomia. Levels of organization (cellular, tissue and organ levels); Modes of coelom formation. Porifera (sponge). Basic Characters, Examples, Types. General characters of Coelentrata, Classification, Examples: *Hydra, Obelia, Aurelia, Alcyonium &* Stony corals. Phylum: Platyhelminthes, Basic characters, Classification, Examples: *Planaria, Fasciola, Schistosoma, Taenia, Heterophyes*. Phylum: Nematodes, Basic Characters & Classification, Examples: *Ascaris, Ancylostoma, Enterobius, Trichinella*. Phylum: Annelida: Basic Characters, Classification, Examples: *Allolobophora, Neries, & Hirudo*. Phylum: Arthropoda: Basic Characters, Classification, some examples. Phylum: Echinodermata: Basic Characters, Classification, some examples. Phylum: Mollusca: Basic Characters, Classification, some examples. Phylum: Rotifera: Basic Characters, Classification, some examples. Phylum: Chordata: Basic Characters, Classification, some examples.

Z103 Functional Morphology: (2h lectures and 2h practical/Weekly)

Different functions and vital activities done by the individual. Nutrition digestion, absorption and metabolism. Respiration- Excretion- Blood Circulation- coordination between functions (through hormones & nervous system).

Z111 General Zoology: (2h lectures and 2h practical/Weekly)

Characteristics of animal kingdom – system of classification and naming of different animal groups – various ecological – physiological – developmental and reproductive a spects for number of selected animals.

Second Level

Z201 Introduction in Entomology: (1h lectures, 2h practical and 1h tutorial/Weekly)

General introductory lecture -Systematic position of insects - Metamorphosis- Properties - Medical and economic importance - head region and its appendages - types of mouth parts - Thoracic region and its appendages - abdominal region and its appendages.

Z202 Coelomic Invertebrates: (2 h lectures and 2h practical/Weekly)

Introduction & General characters. Phylum: *Annellidia* , *Allolobophora, Nereis , Hirudo*- general characters and classification, morphology, anatomy. Arthropoda general characters of classification (Dissection, morphology & anatomy) - Other crustaceans - *Scolopendra, Scorpion* (morphology & anatomy). Spider, Ticks & mites. Phylum: Mollusca (General characters & Classification)- Aplacophora, Monoplacophora, Polyplacophora, Gastropoda, Pelecypoda,- Cephalopoda, Anatomy of *Chiton, Eremina, Anodonta* & *Sepia*. Phylum: Echinodermata (General characters; Classification) - Astropecten anatomy & systems: water vascular system: Reproduction, - Tripneustes anatomy & systems: *Holothuria* anatomy & systems: *Heterometra* anatomy.

Z203 Chordates& Vertebrates: (2h lectures and 2h practical/Weekly)

Study the special characteristic features of the Phylum Chordata. Study the general or common characters of chordate. Compare between chordates and non-chordates.
Study the broad classification of phylum chordata with special reference to the bases of classification. Study the characteristic features of subphylum cephalochordate as well as the structure of all body system of branchiostoma (*Amphioxus*). Study the characteristic features of subphylum urochordate as well as its classification and the structure of all body system of *Ascidia*, as example of this subphylum. Study the characteristic features of subphylum vertebrata as well as the structure of all body systems of *Petromyzon*. Study the characteristic features of class chondrichthyes as dog fish, shark and skates. Mention the general structure of digestive system, urinogenital system and heart with main blood vessels. Study the characteristic features of class oestiochthyes as *Tilapia niloteca*. Study in details the body systems of the fish. Study the characteristic features and classification of class amphibian. Study the characteristic features and classification of amniotes which includes class reptelia, class aves and class mammalia.

Z204 Introduction of Embryology: (2h lectures, 2h practical and 1h Tutorial /Weekly)

General introduction the embryonic stages of chordates, origin of PGCs. Anatomical structures of male reproductive system and spermatogenesis. Spermatogenesis and types of sperm abnormalities. Female reproductive system and oogenesis. Sexual reproductive cycle and types of eggs. Egg membranes and fertilization. Pattern of cleavage and developmental stages of Amphioxus. Early developmental stages of Amphipians. Early developmental stages of Birds. Early developmental stages of Mammals. Ectopic pregnancy in women and twins. Placentation and different types of placenta.

Z205 Introduction of Physiology: (1h lectures, 2h practical and 1h tutorial /Weekly)

Introduction: Definition of physiology & importance of application of this study. Simple knowledge in physiological activities in living organisms, specially human and systems responsible for these activities as: Digestive system (nutrition- digestion- absorption- metabolism – defecation). Respiratory system: (Mechanism of respiration- gas transport-types of respiration). Circulatory

system: (heart- blood vessels- haemopoiesis- functions of blood). Muscular system (types of muscle- structural unit of the muscles- mechanism of muscle contraction. Nervous system: (structure & functions of neuron- central nervous system- peripheral nervous system). Excretory system (structure- mechanism of action). Endocrine glands (structure & function of some endocrine glands).

Z211 Human anatomy: (2h lectures and 2h practical/Weekly)

Essential component of human body from anatomical point of view – axial skeletal system (skull – vertebral column – ribs – sternum) – Appendicular skeleton (upper and lower limbs - pectoral and pelvic girdles – Connection of bone and articulation with muscles – Muscle nomenclature, their position and mechanism of contraction – Heart anatomy and mechanism of pumping – Nervous system (sensory and motor nerve) - Structure of respiratory system - Digestive and urogenital systems.

Z212 Human Physiology: (2 h lectures and 2h practical/Weekly)

Digestive system (nutrition – digestion – absorption – metabolism – defecations). Circulatory system – blood components – Factors affecting blood synthesis- blood diseases. Muscle & nerve structure and factors affecting its activity- Excretion and urine formation – Kidney functions - respiration- gas transport and exchange - Endocrine glands (types, secretion-functions-abnormalities.

ES201 Biodiversity: (2 h lectures and 2h practical/Weekly)
Pre-requisite: Z 102

Ecosystem components and diversity- Categories of biodiversity- importance of biodiversity- components of different habitats-Role of climate nature in biodiversity- Role of biodiversity in ecosystem health- factors affecting biodiversity- threats that biodiversity face in different habitats (air, water, soil)- effect of different pollutants on biodiversity- Extinction- Biodiversity conservation and management in different ecosystems.

Third Level

Z301 Physiology (1): (2h lectures and 2h practical/Weekly)
Pre-requisite: Z 205

A- Nutrition- Digestion- Metabolism: Nutrition & digestion. Hormones of alimentary canal (gastrin- cholecystokimine- entrokinin)- secretion of HCl and bile juice- Intestinal movement and regulation of its secretion. Absorption (normal- abnormal)- defecation. Metabolism: carbohydrate metabolism: glycolysis- kreb's cycle- electron transfere chain- oxidative phosphorelation. Metabolism of monophosphate hexoses. Fat metabolism: metabolism of simple lipids (triglyceride)- metabolism of phospholipids, glycolipids- and cholesterol. Protein metabolism: Metabolism of amino acids- deaminatin- urea cycle- biosynthesis of amino acids. Mal nutrition-metabolism in disease conditions.
B- Endocrine glands: The relation between endocrine system & nervous system – Hormones (chemical structure, control, mechanism of action). Types of endocrine glands, with focusing on hormones of each gland & their physiological functions, Symptoms of hypo and hypersecretion of secreted hormones.

Z302 Comparative Embryology: (2h lectures and 2h practical/Weekly)
Pre-requisite: Z 204

Revision of the main embryonic stages. Morphological aspects of gastrulation and primary organ formation of Amphioxus. Gastrulation of Amphibians and formation of primary organs rudiments. Organs derive from ectoderm, mesoderm & endoderm. Fate map and gastrulation of Birds. Chick embryo (16 hr's, 20 hr's & 24 hr's) incubation. Chick embryo 33 hr's, 48 hr's. embryonic membranes of Birds.

Z303 Radiobiology & its application: (2h lectures and 1h tutorial/Weekly)

Purposes and what is mean – Types of radiation, dose units and apparatus – Biological effects of radiation, direct and indirect – Exposure effects of radiation on gastrointestinal tract – Radio sensitivity and factors affect – Protection and therapy.

Z304 Microtechnique: (2h lectures and 1h tutorial /Weekly)

Preparation of paraffin sections – whole mount preparation of an insect – staining of paraffin sections by hematoxylin and eosin (H&E) – preparation of blood film and staining with H & E.

Z305 Histology: (2h lectures and 2h practical /Weekly)

Introduction, cells, epithelium – connective tissue – blood and bone marrow – muscle – nerve (TBL) – skin (integumentary system) – cartilage and bone – digestive system – cardiovascular system – eye and ear – respiratory system – lymphatic system – urinary system (TBL) – endocrine system – female reproductive system (TBL) – male reproductive system.

Z306 Insect anatomy and systematic: (2h lectures, 2h practical and 1h tutorial/Weekly)

Insect anatomy: principles of insect anatomy - nervous system and its histology
- different types of digestive systems and its histology - muscular system- circulatory system - female genital system and its histology - male genital system and its histology
Insect Taxonomy: Metamorphosis, types of larvae and types of Pupae. Development of wings, general classification, subclass Apterygota (4 orders), subclass pterygota (Division exopterygota, 12 orders), division endopterygota (6 orders).

Z307 Aquatic Invertebrates: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 202

Phylum: Porifera: Sponges- Cnidaria:- Hydrozoa- Schyphozoa- Anthozoa - Phylum Ctenophora rotifera- Phyla:- Rotifera and Bryozoa, Revision • Phylum: *Annelida* (general characters; classification; mode of life; modifications; regeneration & reproduction) • Arthropoda (general characters; classification; trilobitomorpha; crustacea & its development; merostomata; pycnogonida). • Mollusca (general characters; classification; foot in mollusca; pearls formation; shell organization; coiling & torsion; development of mollusca). • Echinodermata (general characters; classification; water vascula system; evolution & phylogeny, reproduction) • Chaetognatha (Arrow worms; characters& phylogeny) - Chordata- Urochordata- Tunicates (characters& phylogeny).

Z308 Parasitology: (2h lectures and 2h practical /Weekly)

Definition of Parasitology terms. Systematic, morphology, anatomy habitat, distribution, life cycle. Diagnosis, pathogenicity, control and treatment of Protozoan parasites. • Platyhelminthes (habitat, morphology, distribution anatomy, life cycle, diagnosis, pathogenicity, control and treatment)• Nematode parasites (habitat, morphology, distribution anatomy, life cycle, diagnosis, pathogenecity, control and treatment).

Z309 Histochemistry: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 101

Principal of histochemistry– the principal of tissue Fixation – carbohydrates – nucleic acids – proteins and amino acids – enzyme histochemistry – pigments – minerals.

Z310 Taxidermy and preparation of museum models: (2h lectures and 1h tutorial /Weekly)

Historical review- materials & chemicals- instruments- methods of collection & hunting- fixatives & pastes- artificial eyes- fixation & transportation- Skinning & tanning- skeleton formation-

invertebrates preservation- dryness (insects)- casting method for fishes & reptiles- embalming birds & mammals – finishing- caring- museum arrangement & show.

Z311 Nervous system in Biophysics: (2h lectures and 1h tutorial /Weekly)

Structure of nervous system- cellular components - neurones- neuroglial cells -synapses- types of nerves- neurotransmitters - receptors- mechanism of nerve impulse transmition. Central nervous system - peripheral nervous system. Sympathetic & parasympathetic nervous system.

ES301 Fundamentals of Ecology: (2h lectures and 1h tutorial /Weekly)

Definition of ecology- Levels of organization- Role of organisms in the ecosystem- Difference between environment, niche and habitat- Population dynamic dispersion and organization- Community structure - Food chain and web- Ecological pyramids- Nutrient cycles- Effect of global warming on the ecosystem- Role of nutrients in the ecosystem and biosphere- Energy flow through the ecosystem- Types of habitats- Types of adaptation- Adaptation vs. acclimation to different habitats- Normality of ecological data.

ES302 Desert Ecology and Egyptian Fauna (2h lectures and 2h practical /Weekly)

Definition and types of fauna- Geography of Egypt- Climate of Egypt and occurrence of desert animals- External sources of heat - Problems faced by desert animals- Adaptation and acclimation- adaptations of desert animals to heat and drought- Life style (habitat, habits, population dynamics, reproduction, adaptation, economic importance, threats and solutions) of desert animals: Egyptian cobra, Desert wolf, Arabian Dorcas gazelle, scimitar horned Oryx, sand cat, scorpions, Fringe eared Oryx, Addax, camels, sand boa, different types of desert lizards- Life style of other Egyptian fauna including Pisces, Amphibians, Aves and Mammals.

ES303 Climate Changes and Biodiversity (2h lectures and 1h tutorial /Weekly)

Forms of global climate changes- Effects of climate changes on human societies- Climate changes and modifications in biodiversity on land and in water at genetic, species and ecosystem levels - Global change drivers (invasive species, habitat fragmentation, ecosystem degradation) - Effects of Climate changes on Environment- Effects of Climate changes on the animal wealth and food supply- Effects of climate changes on species extinctions and interactions between species- Endangered species- Predicting future biodiversity under climate change- How to minimize or reduce climate changes.

ES304 Eco physiology (2h lectures and 2h practical /Weekly)

Definition of Eco physiology or Physiological Ecology- General idea about nutrition- digestion in alimentary canal- contractile movement of alimentary canal- Hormone of alimentary canal- Secretion of HCl- Liver cycle and bile juice- Intestinal movement and regulation of its secretion. Absorption- Fecation. Metabolism: Carbohydrate metabolism: glycolysis- Krebs's cycle- Electron transfer chain- Oxidative phosphorylation. Metabolism of monophosphate hexoses- Metabolic change between different types of hexoses- Glycogen synthesis and glycogenolysis. Fat metabolism: metabolism of simple lipid (triglyceride)- (formation- storage- oxidation) stored lipid- metabolism of phospholipids and glycolipid)- Metabolism of cholesterol- plasma lipid. Protein metabolism: Metabolism of amino acid- deamination - urea cycle- biosynthesis of amino acids- changes of amino acid into specific compound. Mal nutrition- metabolism in disease. Metabolism of nucleic acids. Enzymes. Role of vitamins and trace element.

ES305 Ecotoxicology (2h lectures and 1h tutorial /Weekly)

Introduction and definition of ecotoxicology- History of ecotoxicology, difference between Ecotoxicology and environmental toxicology- Fate of pollutants (contaminants) in the ecosystem- Major classes of contaminants- Routes by which pollutants enter ecosystems- Long-range movements and global transport of pollutants- The fate of metals and radioactive isotopes in

contaminated ecosystems- The fate of contaminants in individual organisms and in ecosystems (their environmental fate) - Effects of pollutants on individual organisms- Introduction to toxicity testing (Eco toxicity testing) - Biochemical effects of pollutants (Uptake, biotransformation, detoxification, bioaccumulation) - Physiological effects of pollutants- Interactive effects of pollutants- Biomarkers- Biological monitoring- Effects of Eco toxicity on populations, communities and ecosystems- Risk assessment and environmental management- Basic transport and dispersal mechanisms of different types of pollutants in the environment and how pollutants can directly and indirectly generate effects at the ecosystem level.

ES306 Natural Resources and Energy Sources (2h lectures and 1h tutorial /Weekly)

Definition of natural resources- Classification of natural resources- Potential resources- Actual resources- reserve resources- Stock resources- Renewable and non-Renewable resources- Depletion of natural resources- Natural resources management and preservation. Energy resources and their role in modern society (national and global scale) - Impacts of nuclear and fossil fuels on the environment- Energy technologies and use of solar, wind, hydro and biomass energy resources- Relationship between public policy and resource usage- Functions of heat engines, heat pumps, solar cells and water and wind turbines- Sustainable Energy- Renewable energy technologies and climate change mitigation.

ES309 Ecology and Egyptian Fauna (2h lectures and 1h tutorial /Weekly)

Basic concept in Ecology: species, populations, communities – Ecology and Economics – Ecology and Tourism – Freshwater and Marine Ecosystems – Ecological interactions: competition, predation and parasitism. Examples of Egyptian animals and their life styles: Fish, Amphibians, Reptiles, Birds, Mammals – Animals in extreme environments – Economic Fauna of Egypt – Conservation of the Egyptian Fauna – Future planning for growing animal production in Egypt.

Fourth Level

Z400 Research project and essay: (2h lectures/Weekly)
Research project in one of different zoology branches – selected by the department and done by the students at the fourth level – special zoology program.

Z401 Research project and essay: (1h lecture/Weekly)
Research project in one of different zoology branches – selected by the department and done by the students at the fourth level – chemistry/ zoology program.

Z402 Experimental Embryology: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 204

Introduction to the experimental embryology. Semen analysis and malformation of sperms - Tissue culture, Nutrional Requirements, basic principles for successful culture - Stem cells and types of stem cells, Properties of adult stem cells, What are Embryonic Stem cells, How are can grow in the laboratory, Comparison between Embryonic stem cells and adult stem cells. Stem cell therapy - Cloning and sexual reproduction, history of animal cloning, how successful was animal cloning and how is cloning done, artificial embryo twinning and somatic cell nuclear transfe - Infertility and In Vitro Fertilization (IVF), Causes of female and male infertility, Preparation of woman to become pregnant - Pattern and causes of congenital abnormalities. Environmental and Genetic causes of congenital abnormalities - Face and limb abnormalities, skull abnormalities and Eye abnormalities - Nervous system abnormalities, Testis and ovaries abnormalities - Regeneration in Invertebrates and Vertebrates, Pattern of Regeneration, Factors controlling Regeneration - Immune System.

Z403 Physiology (2): (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 205

Excretory system: Urine formation- structure of the kidney- functions of the kidney. Muscular system: types of muscles- structure of myofibril- structural and functional unit of muscle-

classification of muscles- mechanism of muscle contraction- factors affecting contraction- Excitation of muscle & energy for muscle contraction. **Nervous system:** Components of nervous system- neurons & neuroglia cells- synapses- central nervous system- peripheral nervous system- autonomic nervous system- sense organs.

Z404 Cell biology& Genetics: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 101

Cell biology: Definition of cell biology – animal cell structure – plasma membrane – nucleus – cell organelles include (Golgi apparatus, Lysosomes, Ribosomes, Endoplasmic reticulum), Mitochondria. Cell structure and functions - Structure and function of cell membrane - Structure and function of extracellular matrix - Cell-Cell adhesion - Cell signaling - protein expression and protein post-transcriptional modifications - Cell cycle and cell cycle regulation - Biology of cancer.
Genetics: Cytogenetics – epigenetics inherited genetic diseases – gene therapy & targeted drug therapy – bioinformatics of genetic disorders.

Z405 Medical and economic insects: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 306

Economically important insects: (Honey bees - division of labor -Honey bee products and its properties as well as uses - Silk worm - Life cycle - Silk production process and treatment - Agricultural Ecofriendly insects) - Medical insects: (disease transfer mechanisms by insects - Female anopheles and its biology - tsi tsi fly and life cycle - female rate fleas and life cycle).

Z406 Biological Associations and Animal Behaviour: (2h lectures and 1h tutorial /Weekly)

Introduction to Biological Associations- Competition- Predation- Cannibalism- Mutualism- Commensalism- Neutralism- Amensalism- Commensalism versus Amensalism- Parasitism. Introduction to and development of Ethology- Fixed Action Pattern definition- Egg rolling or retrieval in the Graylag goose- Mating and aggression in fish- Innate and Learned Behaviour- Human Reflexes and Natural Instincts- Learning and Behaviour- Learning versus Maturation- Types of Learning- Insight Learning- Animal Cognition- Rhythmic Behaviour and Biological Clock- Migration Behaviour- Foraging Behaviour- Social Interactions: Agnostic Behaviour- Territoriality-Communication- Dominance Hierarchy- Social Life.

Z407 Toxicology: (2h lectures and 1h tutorial /Weekly)

Types of toxins- biological changes in toxins- absorption distribution and excretion of toxins- responds for toxins. Tests for toxins in different parts of the body (liver- nervous system- immunological system- kidney- blood- respiratory system- heart- skin- reproductiv system and eyes)- relation between dose and response- chemical causes of cancer- cause of embryonic poisoning- Apoptosis- effect of poisons (pesticide- heavy metals- Radiation- organic solvent and vapors- animal and plant waste- material used for nutrient colouration)- application of toxicology.

Z408 Immunology & Molecular biology: (2h lectures and 1h tutorial /Weekly)
Pre-requisite: Z 101

Immunology: Definition of immunity – the cellular basis of immunity – the nature of antigen – lymphoid organs – immunological memory – immunological tolerance – the functional properties of antibodies – B cell activation – antibody structure – antibody classes – antigen – antibody binding – complement system – T cell responses – classes of T cells – T cell receptor – Major histocompatibility complex (MHC) – MHC-binding co-receptors – selection of T cell repertoire – the role of MHC in transplantation reactions – the Ig super-family.
Molecular biology: Introduction to molecular biology - DNA structure and Function - RNA structure and function - Protein synthesis - Gene mutation - Gene control in prokaryote - Gene

control in Eukaryote – Plasmids - Recombinant DNA - Recombinant DNA Technology, DNA Amplification - Identifying Modified host cells, Expressing the gene of interest - DNA sequencing - PCR and its applications .

Z409 Special Embryology: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z204

Development of stages of chick embryo 72h - Development of stages of chick embryo 96h – Gastrolation of mammals – Formation of primary organs of mammals – Relation between embryo & meternal body in mammals.

Z410 Comparative anatomy and organic evolution: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 203

Revision on chordates and their classification - Body cavity of vertebrates (coelom) - General structure of integumentary system in vertebrates - Study the different types of integumentary glands and exoskeletal derivatives of the integument - Study dentations of the different vertebrate animals - Study the endoskeleton system which includes the axial and the appendicular system where as the former composed mainly of the skull, the vertebral column, ribs and sternum. Study the different types of skull & types of bones of neuro-craniaum and dermato- cranium. - Study of notochord and vertebral column with referring the general types of vertebrae among different vertebrate classes. - Study the circulatory system among different vertebrates with referring to the structure of the heart and types of circulations which includes open & closed circulations, arterial and venous as well as proper and portal circulations. - Study the respiratory system among different vertebrates. - Study the digestive and excretory systems with special reference to the nature of diet and habitat.

Z411 Physiology III: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 205
Hemostatic mechanisms. Receptors – Cellular communication –Cell signaling pathways – Reflexe – Chemical messengers.

Z412 Basic Genetic engineering: (2h lectures, 2h practical and 1h tutorial/Weekly)

Introduction to genetic engineering - Gene structure and function - DNA structure and Function - RNA structure and function - Protein synthesis - Genome and mutation - Gene expression through the processes of transcription and translation - Applications of genetic engineering in various fields - Recombinant DNA - Restriction enzymes - Ligation ,transformation, and production of Recombinant DNA - DNA sequencing - Transgenic Animals

Z413 Fish Biology & Fish Farming: (2 h lectures, 2h practical and 1h tutorial/Weekly)

Fish Biology: I- Adaptation of fish for aquatic life: body shape, size and color variation. Respiration: structure of the Gills, dynamics of gill ventilation, lung fish (air-respiratory fish). Protection: scales, mucus, spines, electrical shocks. Senation: sense receptors, lateral line system, illumination in benthic fish. II- Feeding habits of fish: Herbivorous, Carnivores and Omnivorous fish – Planktivorous fish (filter – feeders). Fish growth factors - Length-weight relationship - Age determination. III- Food digestion in fish: mouth position, size, teeth arrangement. Stomach anatomy in herbivorous and carnivorous fish. Intestine form and length. IV- Fish schooling and migration behavior. V- Fish reproduction: Maturity ripeness, gonadosomatic index. Induced spawning in fish, breeding season, breeding tactics. Nest building and Parental care in Tilapia. External and internal fertilization, egg fecundity.
Fish Farming: I- Aqua culture and Economy, Global fish production, Fish as a valuable source of animal protein. II- Type of fish culture. III- Fish farm construction: Farm location and size. Feeding farmed fish – fish farm fertilization - supplementary food in fish farm - fish farm aeration. IV- Monosex culture, Mixed fish culture, Itensive fish culture, Cage fish culture, fish-rice culture. V- Pollution and diseases in fish farms. VI- fish culture and future planning in Egypt.

Z414 Cell biology & Histochemistry: (2h lectures and 2h practical /Weekly)
Pre-requisite: Z 101

Cell biology: Definition of cell biology – animal cell structure – plasma membrane – nucleus – cell organelles include (Golgi apparatus, Lysosomes, Ribosomes, Endoplasmic reticulum) , Mitochondria. Cell structure and functions - Structure and function of cell membrane - Structure and function of extracellular matrix - Cell-Cell adhesion - Cell signaling - protein expression and protein post-transcriptional modifications - Cell cycle and cell cycle regulation - Biology of cancer.
Histochemistry: Principal of histochemistry- the principal of tissue Fixation – carbohydrates – nucleic acids – proteins and amino acids – enzyme histochemistry – pigments – minerals.

Z415 Fish Biology: (2h lectures and 1h tutorial /Weekly)

Morphological and Anatomical features of fish (bony and cartilaginous) – Common fishes of Egypt (Freshwater and Marine fish) – Fish respiration (gills and lungs) – Swimming activity of fish – Spawning tactics in fish – Specific adaptations of fish – Fish in extreme environments – Dominance hierarchy in schooling fish – Fish and protein supply in Egypt.

Z421 Biophysics Cell Communication: (2h lectures and 1h tutorial /Weekly)

Cell structure and functions - Structure and function of cell membrane - Structure and function of extracellular matrices - Cell-cell adhesion - Cell signaling pathways - Cell cycle - protein expression.

Z422 Cytogenetics: (2h lectures and 1h tutorial /Weekly)

Cytogenetics – epigenetics inherited genetic diseases – gene therapy & targeted drug therapy – bioinformatics of genetic disorders.
ES400 Research project and essay: (2h lectures/Weekly)
Research project in one of different zoology branches – selected by the department and done by the students at the fourth level – Environmental Sciences program.

ES401 Bioindicators of Pollution: (2h lectures and 1h tutorial /Weekly)

Difference between bioindicators, biomarkers, biotic indices and biomonitoring-Criteria for selecting bioindicators- Types of bioindicators - Bioindicator species-How are bioindicators used?- Role of climate in bioindication- Bioindicators of air pollution- Bioindicators of water pollution- Bioindicators of soil pollution- Ways of assessment of different bioindicators- How to apply using bioindicators in social benefits?- Why bioindicators are better than traditional methods?

ES402 Environmental Pollution and Biological Analysis :(2h lectures, 2h practical and 1h tutorial/Weekly)
Definition of environmental pollution- Sources and Types of environmental pollution- Urbanization and Urban Pollution- Kinds of Urban Pollution: Air Pollution- Water Pollution- Noise Pollution- Radioactive Pollution- Thermal Pollution- Visual Pollution- Land Pollution- Light Pollution- Littering- Plastic Pollution- Urban heat islands- Meaning of Biological Analysis- Biological analysis of the Heavy Metals in fluids and tissues- Biological analysis of Benzene in the blood samples- Biological analysis of Sulphur Dioxide- Blood collection and hematological analysis- Complete Blood Count (CBC)- Oxidative Stress Biomarkers- Chromatography Techniques- Gel electrophoresis- Estimation of total lipids, total proteins and total carbohydrates in crops, fish and meat- Chemical and Biological analysis of water.

ES403 Ecosystem and Biome: (2h lectures and 1h tutorial /Weekly)

Ecosystem concepts- Ecosystem components- Abiotic Factors- Biotic Factors- Pond as an Ecosystem- Aquatic Ecosystems- Terrestrial Ecosystems- Energy flow through an Ecosystem- Ecosystem Equilibrium- Biome concepts- Difference between biome and ecosystem- Difference between biome and habitat- Desert biome- Forest biome- Grassland biome- Tundra biome-

Aquatic biome- Tropical rainforest biome- Deciduous forest biome- Savannah biome- Ecosystem and Human activities.

ES404 Distribution Pattern, Population Dynamics and Community Ecology (2h lectures and 1h tutorial /Weekly)
Patterns of Animal Distribution- Global warming effects on Animal Distribution- Population growth Models: BIDE model- Exponential population growth models-Density dependence- Logistic population growth models- Exponential growth curves- Logistic growth curves- Logistic equation- Competitive exclusion principle- Environmental carrying capacity- Environmental resistance- Population regulation- Population viability analysis- Population cycles -Ecological niche- Niche breadth and overlapping- Intraspecific versus Interspecific aggregation- Ecological interactions- Definition of Community- Community dynamics- Community changes over time- Community succession- Global Biogeography- Zonation Patterns.

ES405 Environmental Pollution Control and Prevention: (2h lectures, 2h practical and 1h tutorial/Weekly)
Fundamentals of prevention and control of industrial air pollution- Methods to control gaseous pollutants- Methods to control particulate emissions- General air pollution control devices for industries- Steps for reduction of air pollution- Clean Air Implementation Plans- Prevention and Control of Indoor air pollutants - Comprehensive Waste Management- Phytoremediation- Bioremediation- Bio augmentation- Cost of Control Measures- Fundamentals of prevention and control of industrial water pollution- Prevention and Control of industrial waste and water pollution- Fundamentals of prevention and control of soil erosion- Prevention and Control of Domestic waste- Mitigation of Noise pollution- Conservation and protection of environment.

ES406 Sustainable Environmental Planning: (2 h lectures and 1h tutorial /Weekly)

Principles of environmental planning, including the legal, economic, ethical, and ecological foundations of planning- Applied case studies of environmental planning for human health, natural areas, working and landscapes- Urban environmental planning- Applied case studies on sustainable agriculture, fisheries, forestry, freshwater, marine, water, and wildlife resources- Green Economy- Ecofriendly Strategies for environmental sustainability- Environmental planning in Natural Protectorates- Egyptian Environmental Law- Egyptian Environmental Affairs Agency.

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