Course Contents of the Mathematics Department

MATH 301: Abstract Algebra (1) (Group Theory) Cr. Hr. (L3+Sc 1)
Prerequisite: (-)
Groups - Subgroups - Symmetric groups - Cyclic groups – Lagrange' Theorem – Normal subgroups – Homomorphisms - Quotient groups – Isomorphisms Theorems – Applications - Direct product of groups – Cayley's Theorem - Sylow's Theorems – Solvable and nilpotent groups

MATH 302: General Topology 3 Cr. Hr. (L3+Sc 0)
Prerequisite: (-)
Topological spaces -Review of metric spaces, definition of topological spaces, topological properties - Derived topological spaces and continuity - Connectedness -Connectedness, cubsets, path connectedness, connected components - Separation axioms - Compactness - (Closed bounded intervals, Commpactnes and subspaces, compact subsets of R^) Metric topological spaces.

MATH 303: Numerical Analysis 3 Cr. Hr. (L3+Sc 1)
Prerequisite: (-)
The concept of error and error propagation – Iterative Solution of non-linear equations (Bisection – false position - Fixed point iteration – Newton's Raphson - Secant).Solution of linear algebraic systems direct methods (Gauss elimination – LU decomposition) iterative methods (Jacobi – Gauss Seidel – Successive over-relaxation). Interpolation by polynomials (Lagrange – Newton's divided difference – forward and backward difference operators) Curve fitting (least squares) Numerical differentiation and integration. Difference equations.Numerical solution of ordinary differential equations (Euler – RungeKutta – Shooting – Finite difference).

MATH 304: Measure Theory 3 Cr. Hr. (L3+Sc 0)
Prerequisite: Math 204
1 How to Count Rectangles: A Review of Integration - Riemann Revisited - Shortcomings of Riemann Integration . - Outer and Inner Measure . - Measurable Sets - Measurable Functions - Simple Functions The Lebesgue Integral (Integrating Bounded Measurable Functions - Criteria for Integrability - Properties of the Lebesgue Integral - Integrating Unbounded Measurable Functions - Comparison of Lebesgue and Riemann Integrals) .

MATH 305: Differential Gemetry 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
Local curve theory (Arc length – Curvature &Frenet – Apparatus – Frenet–Serret theorem); Local Surface theory (Surfaces – The first fundamental form – Normal curvature, Geodesic curvature – Gauss's formula – Geodesics – The second fundamental form & the Weingarten map – Principle, Gaussian, Mean and normal curvatures – Riemann's Curvature & Gauss's theorem a egregium).

MATH 306: Operational Research 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
History and nature of Operations Research , Introduction to system analysis, Problem investigation and formulation, Linear programming and its graphical solutions with applications, Graphical sensitivity analysis of linear programs, Transportation models,

Assignment models, Introduction to graph theory and networks, The shortest path problem, Introduction to stochastic model in operations research.

MATH 307: Theory of Algorithms 2 Cr. Hr. (L2+Sc 0) Prerequisite: (-)
Introduction: what is algorithm, problems, instance, efficiency of algorisms, average & worst analysis, Data structure (list, graph, rooted tree, heap, disjoint set structures), Analyzing the efficiency, Asymptotic notation, Analysis of algorithms, Solving recurrences. Greedy algorithms: minimal spanning tree, shortest paths, minimizing time in systems, Scheduling with deadlines, Coloring a graph, Traveling salesman problem. Divide & Conquer algorithms: Determining the threshold, Binary searching, Sorting (merging, quick sort), Arithmetic with large integers, Exponentiation, Matrix multiplication. Dynamic Programming: world Series, Chain Matrix multiplication, shortest paths, optimal search trees, Traveling salesman problem.

MATH 308: Mathematical Cryptography 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
An introduction crypto graphy (simple substitution ciphers, symmetric and asymmetric ciphers Wards and Norms- A Little bit of theory (Safety First)- Mac Data- Public Key Cryptography- Duffy - Aekman key exchange, They basic idea of public key cryptography, and Elcramal crypto system, The RsSA public key erypto system - How can we stay anonymous?- Cipher systems, prefect security - Postscript- Deciphering the cipher Text.

MATH 311: Mechanics of continuous media 3 Cr. Hr. (L3+Sc 0)
Prerequisite: (-)
1-The Continuous Medium. 2-Stress:Body forces and surface forces, Traction or stress vector; Principal axes of stress and principal stresses; Invariants; spherical and deviatoric stress tensors, Mohr's circles, Plane stress, Stress resultants in the simplified theory of bending of thin plates. 3-Strain and Deformation: Small strain and rotation in two dimensions, Small strain and rotation in three dimensions,Kinematics of a continuous medium; Material derivatives, Rate-of-deformation tensor (Stretching); Spin tensor, Natural strain increment, Finite strain and deformation; Eulerian and Lagrangian formulations; Geometric measures of strain; Relative deformation gradient, Rotation and stretch tensors, Compatibility conditions; Determination of displacements when strains are known. 4- General Principles: Integral transformations; Flux, Conservation of mass; The Continuity equation, Momentum principles; Equations of motion and equilibrium, Couple Stresses, Energy balance; First law of thermodynamics; Energy equation, Principle of virtual displacements, Entropy and the second law Thermodynamics; Clausius-Dubem inequality, The Caloric equation of state; Gibbs relation; Thermodynamic Tensions; Thermodynamic Potentials; Dissipation Function. 5- Constitutive Equations:Ideal Materials, Classical elasticity; Generalized Hooke's law; Isotropy, hyperelasticity; The strain energy function; Elastic symmetry; Thermal stresses; Fluids; Ideal Frictionless fluid; Linearly Viscous (Newtonian) Fluid; Stokes condition of vanishing bulk vicosity; Laminar and Turbulent Flow.

MATH 312: Electrodynamics 3 Cr. Hr. (L3+Sc 0)
Prerequisite: MATH 212
1.The representation of the electromagnetic field : The field equations - The equation of continuity - Dielectric constant and permeability - Solutions for free space conditions , for homogenous isotropic meduim and for conducting medium - Harmonic waves and wave equation - Electric and magnetic polarization -The scalar and vector potentials - The potiental in a homogenous conducting media - The Herts and Fitzgerald vectors - The scalar potential of a point charge - The Dirac delta Dirac function - Retarded potentials - The Poynting's theorem

and the compl;expoynting vector - boundary conditions. 2. Refraction: The plane wave - Harmonic plane wave - The effect of conductivity - Refraction at a plane interface (Fresnel reflaction) - The incident electric field perpendicular to the plane of incidence - The incident magnetic field perpendicular to the plane of incidence - Reflected and refraction by a dielectric media -the plane slab. 3. Radiations: Waves between parallel planes - Transverse electric waves - Transverse magnetic waves -Characteristics of TE and TM waves -Transverse electromagnetic waves - The electric or Hertz dipole - The magnetic or Fitzgerald dipole - The harmonic electric dipole - The harmonic magnetic dipole - The radiation efficiency and the radiation resistance.

MATH 313: Quantum Mechanics I **3 Cr. Hr. (L3+Sc 0)**

Prerequisite: (-)

1.Mathcmatical Introduction: Linear vector spaces with the Dirac notation- Inner product spaces- Linear operators - Unitary operators - Self-adjoint operators - Matrix elements of operators - Dirac δ-function - The eigenvalue problem with the discrete and continuous spectrum, the degenerate case - Functions of operators. 2. The Basic Concepts of Quantum Mechanics: Physical introduction (Double-slit Experiment, de Broglie waves, photo-electric effect) - The postulates of quantum mechanics - The uncertainty principle - The principle of superposition - The measurement concept in quantum mechanics and the complete set of physical quantities - The Heisenberg uncertainty relations, The energy-time uncertainty relation - The density matrix. 3. The Schrodinger's Equation: The Schrodinger's equation – Time reverse - The current density - General properties of solution of Schrodinger's equation – Problems in one dimension (The free particle - The particle in a box – The single-step potential – The harmonic oscillator). 4. The classical limit. 5. The conservation Laws in Quantum Mechanics: The differentiation of operators with respect to time and Ehrenfest's theorem - Time translational invariance and conservation law of energy - Stationary states - Time shift operator - Operator of space translation, Translational invariance and conservation law of momentum - Parity invariance- Operators of rotations in two- and three dimensions - Angular momentum, Eigenvalues and eigenfunctions of angular momentum - Rotational invariance and conservation law of angular momentum - Addition of angular momenta - Angular momentum selection rules.

MATH 314: Quantum Mechanics II **3 Cr. Hr. (L3+Sc 0)**

Prerequisite: (-)

l. Motion In a Centrally Symmetric Field: General treatment and general properties of the wave function in the limiting cases - Spherical waves - Motion in a Coulomb field (Hydrogen atom or hydrogen-like ion) - Multielectron atoms (Energy levels and electron states in the atoms) - Periodic table. 2. Approximation methods: The variational method - The Wentzel-Kramers-Brillouin method - Time-independent perturbation theory – Time -dependent perturbation theory - Transitions in the continuous spectrum - Intermediate states - Quasi-stationary states. 3. Spin: Spin - Spin operator – Spinors – The wave functions of particle with arbitrary spin – Operator of finite rotations - Polarization of electrons - A particle in a magnetic field - Motion in a uniform magnetic field - Fine structure of atomic levels. 4. Identical particles: The principle of indistinguishability of similar particles - Exchange interaction – The symmetric and anti-symmetric states -Second quantization, the case of Bose statistics -Second quantization, the case of Fermi statistics.

MATH 316: Fluid Mechanics **2 Cr. Hr. (L2+Sc 0)**

Prerequisite: (-)

Basic equations of fluid motion - Two-dimensional of incompressible fluid - Irrotational motion in three dimensions - waves in incompressible fluid - Dynamical similarity and dimensional analysis – motion of compressible fluid - Dynamics of real fluid - Turbulent

flow - Boundary layer theory - Theory of stability.

MATH 317: Special Functions 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
Gamma and Beta functions and (Euleis definition, Relation between Gamma and Beta functions) other related Functions and their properties – Fourier serier (For functions with Period 2π, 2ℓ – Conditions for the Fourier Expansion – Odd and Even Functions – Sine Series and Cosine Series) – Orthogonality relations – Bessel Functions (Bessel function of order of second kind, Recurrence formulas', Bessel function whose order is an oddmultipec of ½) – Legendre's and Hirmet's Polynomials.(The Rodrigue's formula of LP, the generating function of LP the orthogonality of LP and HP, Recurrena for LP and HP).

MATH 318: Theory of Elasticity 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
1.Theory of Strain:Components of small deformation - Components of finite deformation - Volumetric Strain - Angle of rotation of material elements - Compatibility of equations. 2. Theory of Stresses: State of stress in the body - Differential equation of equilibrium - Stresses on inclined areas (surface conditions) - Cauchy's stress surface - Transformation of stresses tensor components when the coordinate axes are rotated - Maximum shearing stresses. 3. Relation between stresses and strain: Generalized Hook's law - Strains expressed in terms of stresses - Stresses expressed in terms of strain - Equation of Lame. 4. Application of Elasticity:Airy's function - Solution of plane problems of elasticity by means of a complex variable functition - Some problems on Lame's equation - Propagation of elastic wave.

MATH 319: principles of Mathematical Modeling 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
1. Modeling with difference equations: Introduction to difference equations - Modeling change with difference equations- Solutions to the model - Systems of difference equations. 2. Model fitting: Fitting models to data graphically - Analytic methods to model Fitting. 3. Linear programming: Introduction to linear programming - Geometric solutions to linear programming - Algebraic solutions to linear programming - The Simplex Method. 4. Modeling with O.D.E's: Population Growth.

MATH 322: Combinatorics 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
Introduction to basic ideals (Basic principles of counting,– Selections and binomial coefficients permutations and combinations, the binomial coefficients Tree diagram) - Pairings Problems -- Recurrence and generating functions-Recuirence relation, Linear recurrence, Neojton's Binomial theorem, Exponential generating function and petition of integers) - The Inclusion-Exclusion Principle and Applications.

MATH 324: Principles of Measure Theory 2 Cr. Hr. (L2+Sc 0)
Prerequisite: MATH 204
1 How to Count Rectangles: A Review of Integration - Riemann Revisited - Shortcomings of Riemann Integration . - Outer and Inner Measure . - Measurable Sets - Measurable Functions - Simple Functions The Lebesgue Integral (Integrating Bounded Measurable Functions - Criteria for Integrability - Properties of the Lebesgue Integral - Integrating Unbounded Measurable Functions - Comparison of Lebesgue and Riemann Integrals) .

MATH 331: Principles of Calculus of Variations 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
1.The method of varation in problems with fixe boundaries: Variation and its Properties Euler's Equation - Functionals of the form $\int_{x_0}^{x_1} F(x, y_1, y_2, ..., y_n, y'_1, y'_2, ..., y'_n)\, dx$ Functionals dependent on higher-order derivatives - Functionals dependent on the functions of several variables - Variational problems in parametric form – Some applications. 2.Variational problems with moving boundaries: An elementary problem with moving boundaries - the moving boundary problem for a functional of the form $\int_{x_0}^{x_1} F(x, y, z, , y', z')\, dx$ - Extremalswith corners - One-sided variations. 3. Sufficient Conditions for an Extremum:Field of extremals-The Weierstrass function *E (x, y, p, y').*

MATH 332: Gas Dynamics 2 Cr. Hr. (L2+Sc 0)
Prerequisite: (-)
1-Review of thermodynamics: First law of thermodynamics – Second law of thermodynamics –Thermal and calorical properties- Entropy change- Isentropic flow of a perfect gas. 2-Wave propagation: Speed of sound – Mach number – Wave propagation. Steady one dimensional flow: Velocity relation (adiabatic flow) – Mass flow rate – Nozzel – Gas flow through Nozzel - Convergent/ Divergent Nozzle. 3-Normal and Oblique Shock waves: Equation of motion for a normal shock wave – The normal shock wave for a perfect gas – Hugoniot equation – Rankine/ Hugoniot equations - Oblique Shock and expansion waves – Prandtl-Meyer function – Fanno flow – Rayleigh flow. Potential equation for compressible flows: Crocco s theorem – General potential for three dimensional flow- linearization of the potential equation - potential equation for bodies of revolution – Two dimensional compressible flow – General linear solution for supersonic flow- method of characteristics .

MATH 333: Abstract Algebra for Computer Science 3Cr.Hr(L2+Sc2)
Prerequisite: (-)
This course provides basic definitions and facts of groups (finite group, order of a group, subgroups, cyclic groups), rings, fields (finite fields, Galois fields GF(p), GF(2^n), modular polynomial arithmetic, and finding the multiplicative inverse in Galois fields).

MATH 341: Introduction to Ordinary Differential Equations 2 Cr. Hr. (L2+Sc 0)
Prerequisite: MATH 245
Differential equations of order one and degree one - Differential equations of order one and higher degree one –Existence and uniqueness of solutions – Picard's Method of successive approximations of initial value problems - Applications of differential equations of order one in (Physics – **Mathematics** – Chemistry- …) - Higher order differential equations with constant coefficients - Higher order differential equations with variable coefficients – Laplace Transformations - Indeterminate forms - linear systems of first order difference equations.-

MATH 342: Applied Linear Algebra 2Cr. Hr. (L2+Sc. 1)
Prerequisite: (-)
Systems of Linear equations (Some applications: Network flow, Electrical net works, Economic, chemistry and Mechanics) - Matrices – Determinants – Euclidean and general Vector spaces - subspaces and bases – Linear Transformation (Kernel and Range) - Inner

product spaces – Orthognality - Eigenvalues & Eigenvectors – Diagonolization. Applications.,

Course Contents of the Statistics

STAT 301: Statistical Inference (I) **3 Cr. Hr. (L3+Sc1)**
Prerequisite: STAT 202
Point estimation: Properties of point estimators (sufficiency, unbiasedness, minimum variance, consistency,)-Methods of estimation –estimators-Interval estimation: Methods of finding confidence intervals- Confidence intervals for some parameters. Bayesian statistics (Bayesian point estimation- Bayesian interval estimation- Bayesian testing Procedures).

STAT 302: Statistical Inference (II) **3 Cr. Hr. (L3+Sc 1)**
Prerequisite: STAT 202
Statistical hypothesis - Test of hypothesis - Critical region -Type and size of errors - Power function - Size of test- Simple likelihood ratio test- Best critical region - Most powerful test - Neymann-Pearson theorem- Generalized likelihood ratio test- Uniformly most powerful test- Testing on the mean of a normal population ,Testing on the variance of a normal population- Testing the equality of two means - Testing the equality of two variances-Chi-square goodness of fit tests- Test of independence in contingency tables-Bayes' tests.

STAT 303: Stochastic Processes (I) **3 Cr. Hr. (L3+Sc 1)**
.Prerequisite: STAT 205.
Compound distributions- Conditioning (computing probabilities by conditioning, computing expectation by conditioning, applications) – The exponential distribution and the Poisson process- The simplest time dependent stochastic processes (Pure birth process, birth and death process)— Branching processes – Simple random walk .Discrete time mavkou chains (champman - kolmogorou equations - classification of states limiting probabilities applications)

STAT 304: Sampling Techniques **3 Cr. Hr. (L3+Sc 0)**
Prerequisite:
Sampling with and without replacement-Independent sampling-Simple random sampling : estimation of a population mean, total , and proportion; selecting the sample size for estimating population mean, total , and proportion - Stratified sampling: estimation of a population mean, total , and proportion; selecting the sample size for estimating population mean, total , and proportion ; allocation of the sample - Cluster sampling :estimation of a population mean , total ,and proportion; ,selecting the sample size- Systematic sampling ,estimation of a population mean , total , and proportion ; selecting the sample size.

STAT 305: Order Statistics **3 Cr. Hr. (L3+Sc 1)**
Prerequisite: STAT 202
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)- Moment relations, Bounds, and Approximations - The percentage point - Recurrence relations of two order statistics- The distribution of coverages - Distributions derived from the distributions of order statistics. Asymptotic theory of order statistics.

STAT 306: Non-Parametric Statistics **3 Cr. Hr. (L3+lab1)**
Prerequisite:
Tests of goodness of fit-Tests based on runs- Sign test (the sign test-the signed rank test)-Tests of the equality of two samples- Tests of the equality of k dependent samples-Measures of

association for bivariate samples- Measures of association in multiple classification. categorical data analysis (chi square and goodness of fit, contingency tables, Fisher exact text). Rank regression.

STAT 310: Characterization Theory **3 Cr. Hr. (L3+Sc 0)**
Prerequisite: Math 202+STAT 202
Notion of characterization- Characterizations based on truncated distributions- Characterizations by properties of order statistics-Characterizations by statistical properties- Characterizations by independence of linear and nonlinear statistics-Characterizations associated with mathematical theory of reliability. characterizations using regression properties.

STAT 311: Simulation and Modeling **3 Cr. Hr. (L3+Sc 1)**
Prerequisite: STAT 202
Some techniques for generating sequences of random numbers - Testing the randomness of generating sequence of pseudo random numbers- General techniques for simulating discrete and continuous random variables- Applications for some discrete and continuous probability distributions- Variance-reduction techniques- Simulating some models in operations research.

STAT 312: Survival Analysis **3 Cr. Hr. (L3+Sc 0)**
Prerequisite: STAT 202
Parametric survival models- Non-parametric survival models- Models for discrete data and extensions- Competing risks- Unobserved heterogeneity- Multivariate survival. censoring and life tables - parametric survival models under censoring-Fitting parametric regression models - Linear regression with censored data. Hazard models.

STAT 313: Demography Analysis * (3 Cr.Hr. (3+0))
Prerequisite: STAT 102
Demography and population statistics- Key concepts of demography (person- family-household-dwelling unit- population size- population density- age- age pyramid- gender-marital status-area)- Population phenomena (population change factors- fertility- mortality-marriage rate- divorce rate -migration rate)-Population as basis for key ratios (key ratio-indicator for size of population phenomena- cross sectional information- information from the turn of the year- period information - information from a certain time period- cohort)-Measurement of population phenomena (measurements of birth rate, fertility, death rate, infant mortality, and life expectancy-measuring: marriages, divorces, migration and age standardization)-The life table.

STAT 314: Reliability Theory **2 Cr.Hr. (L2+c 0)**
Prerequisite:
Basic concepts of reliability theory- Coherent structures and their representation in terms of paths and cuts- Parametric families of distributions of direct importance to failure models- Classes of life distributions based on motions of aging- Reliability function for different kinds of systems- Reliability network of systems and structure functions- Testing of reliability hypothesis. systems with repair.

STAT 315:Probabilistic Methods in Operations Research (II) 3Cr. Hr. (L3+Sc 1)
Prerequisite: STAT 204
Waiting line models (The structure of queuing situations – Terminology and basic relationships – Analysis of a simple queue – Single-channel finite and infinite calling population, finite and infinite maximum queue- Multichannel, finite and infinite calling population, finite and infinite maximum queue – Inventory models (Deterministic inventory models "shortage and no

shortages allowed" – stochastic inventory models "P and Q systems") - Forecasting models - Probabilistic inventory models.

STAT 316: Categorical data analysis **2 Cr.Hr. (L2+lab 1)**
Prerequisite: STAT 203
Inferences about a population proportion and the difference between two population proportion. Inferences about several proportions, chi-square goodness of fit tests. contingency tables tests for independence and homogeneity. Measuring strength of relation. odds and odds ratios.

STAT 317: Selected topics in Industrial Statistics **3 Cr. Hr. (L3+Sc 0)**
Prerequisite:.
This course could be one of the following topics, or any other recent topic on industrial statistics, approved by the department: Reliability and product lifetime analysis- Empirical model building for industrial decisions- Design and analysis of experiments for industrial decisions.

STAT 318: Selected Topics in Statistics (2) **2 Cr.Hr. (L2+Sc0)**
Prerequisite:
Control charts (elements of control charts-control charts for sample means-control charts for ranges-control charts for fraction defective)- Allowable width of control limits when tolerance limits are specified- Acceptance sampling by attributes (single sampling plans-double sampling plans-sampling by variables). Modeling process quality. Inferences about process quality. process and measurement system capability analysis.

STAT 319: Introduction to Simulation and Modeling **2 Cr.Hr. (L2+Sc 1)**
Prerequisite: STAT 202
Some techniques for generating sequence of random numbers - Testing the randomness of generating sequence of pseudo random numbers- General techniques for simulating discrete and continuous random variables- Application for some discrete and continuous probability distributions- Variance-reduction techniques- Simulating some models in operations research. simulating a non-homogeneous poisson process. simulating a two-dimensional poisson process.

STAT 320: Regression Analysis **3 Cr. Hr. (L3+lab1)**
Prerequisite: STAT 205
Simple linear regression (least squares estimates - point estimation of mean response - residuals - properties of fitted regression line - estimation of error terms variance - Gauss-Markov theorem - normal error regression model - sampling distribution of estimators of model parameters - inferences concerning model parameters - inferences concerning mean response - prediction of new observation - analysis of variance approach to regression analysis - descriptive measures of association regression model - adequacy off regression model - transformations)Multiple linear regression (matrix approach to multiple linear regression - hypothesis tests in multiple linear regression).

STAT 321: Introductory Statistics for Biological programs **2Cr.Hr. (L2+lab1)**
Prerequisite: STAT 209
Descriptive statistical analysis (Ordered array, Grouped data, Frequency distributions, Measures of central tendency and measures of variation) – Probability distributions (Discrete probability distributions, Binomial and Poisson distributions, Continuous probability distributions, Normal distribution, Applications) . Point and interval estimations – estimation

of population mean, proportion and variance. Tests of hypotheses: tests on population mean, proportion and variance– testing the difference between two population means, population proportions two population variances. one-way analysis of variance – two-way analysis of variance.

STAT 322: Selected Topics in Econometrics 3 Cr. Hr. (L3+Sc0)
Prerequisite: Department approval
This course could be any one of the following topics or any recent topic on econometrics approved by the department.
The Generalized Linear Statistical Model, Simultaneous Linear Statistical Models, Some Procedures for Handling an Unknown Covariance Matrix, Pooling of Data and Varying Parameter Models: Using Time Series and Cross-sectional Data.
Models with Qualitative or Limited Dependent Variables, Unobservable Variables.
Non-sample Information, Biased Estimation, and Choosing the Dimension and Form of the Design Matrix.
Nonlinear Statistical Regression Models.
Time Series and Distributed Lag Models.

STAT 323: Introduction to statistical Inference 2 Cr.Hr. (L2 +Sc1)
Prerequisite: STAT 213.
The objective of this course is to introduce the basic ideas and methods of statistical inference and thepractice of statistics, especially estimation and basic regression analysis. Mathematical statistical theory will be supplemented by simulate and data analysis methods to illustrate the theory.

STAT 325: principles of sampling Methods 2 Cr.Hr. (L2+Sc0)
Prerequisites:
Discussion of the main designs and estimation techniques used in sample surveys: simple random sampling, stratification, cluster sampling, double sampling, post-stratification, ratio estimation, and non-response and other non-sampling errors. sample size estimation systematic sampling. subsampling with (equal - nonequal) size. source of errors in surveys.

STAT 328: Simulation and Modeling Techniques 2 Cr.Hr.(L2+Sc1)
Prerequisite: STAT 213
The aim of the course is to introduce students to the concepts, techniques and applied aspects of the development and analysis of simulation models. The course will cover two main approaches for modelling problems bound by uncertainty (stochastic behaviour): Monte-Carlo Simulation (static problems) and Discrete Event Simulation (dynamic problems). Topics covered will include: types of uncertainty; types of simulation modelling; sampling methods; the simulation process; structuring problems for simulation; running simulation models; analyzing simulation outputs; risk analysis using simulated models; testing and validating simulation models; applications of simulation. optimal tests of hypothesis. Inferences about normal models.

STAT 330: Introduction to Econometrics 2 Cr.Hr.(L2+Sc1)
Prerequisite: (-).
This course takes as its starting point ordinary-least-squares estimation and the linear regression model, which are presented utilizing vector and matrix notation. This is followed by the application of OLS to non-linear models. Topics include: nonlinear-least-squares, two-stage estimation, instrumental variables, simultaneous equations, maximum likelihood estimation, and logit/probit models.

STAT 351: Elementary Statistical Methods For Biomathematics
2Cr.Hr.(L2 + lab1)
Prerequisites: (-)
Frequency Distributions, Data Description, Confidence intervals and sample size (mean, proportion, variance and standard deviation). Hypothesis Testing (mean, proportion, variance, difference between two means, two proportions, and two variances).Correlation and regression. Chi-Square tests (test for goodness of fit, test of normality, tests using contingency tables). Analysis of Variance (one-way analysis of variance, two-way analysis of variance).Non parametric methods.

Course contents of the Computer Science

COMP 301: Advanced Programming Language 3Cr.Hr (L2+P 3)
Prerequisite:COMP 205.
This course provides an advanced program design and implementation using one of the modern programming languages such as Java. Topics include object-oriented and event-driven concepts including the API, classes and objects, applications, applets, inheritance, polymorphism, Graphics and graphical user interfaces, layout managers, exception handling, collections, generics multithreading, and RMI.

COMP 302: Algorithmic Combinatorics 2Cr.Hr (L2+Sc1)
Prerequisite:COMP 201
The course provides fundamentals methods for counting and algorithms for listing basic combinatorial objects. Topics include two basic counting principles, arrangements and selections without and with repetitions, distributions, combinatorial arguments and block walking proofs, algorithms for permutations, subsets, integer partitions, product spaces, and set partitions.

COMP 303: Syntax and Semantics of Programming Languages 2Cr.Hr (L2+P 0)
Prerequisite: (-)
The course provides an understanding of formal models of programming languages: syntax and semantics. Topics include grammars types, parse trees, ambiguity, abstract syntax, attribute grammars, decoration trees, two-level grammars, and translation semantics or axiomatic semantics.

COMP 304: Compiler Design 3Cr.Hr (L2+P 2)
Prerequisite:COMP 205, COMP 208, COMP 303.
This course introduces the basic concepts and techniques of constructing a compiler for a primitive programming language. It covers the theoretical aspects of compiler design as well as the multitude of practical considerations. Topics include language definition, compiler design, lexical analysis, syntax analysis, semantic analysis, (intermediate) code generation, and optimization techniques.

COMP 305: Theory of Complexity 3Cr.Hr (L3+P 0)
Prerequisite:COMP 201
This course introduces a diverse array of complexity classes (such as P, NP, NP-complete) that are used to classify problems according to the computational resources (such as time, space)

required for their solution. The course examines problems whose fundamental nature is exposed by this framework (such as SAT, and 3-SAT problems), the known relationships between complexity classes, and some problems in the area.

COMP 306: Computer Graphics **3Cr.Hr (L2+P 2)**
Prerequisite:COMP 201, COMP 205
The course provides the fundamentals of computer graphics. Topics include computer Graphics and their applications, elements of pictures created in computer graphics, interactive Graphics system, algorithms for points, lines, circles, ellipse and other curves, transformation techniques, and 2D/3D viewing. Perspective and parallel projections will be included as well as rendering techniques.

COMP 307: Operating Systems **3Cr.Hr (L3+P 0)**
Prerequisite:COMP 202.
The course provides the student with an introduction to the fundamentals of operating system function, design, and implementation. Topics include computer and operating system structures, processes, threads, CPU scheduling, process synchronization, deadlocks, and an introduction to memory management.

COMP 308: Cryptography **3Cr.Hr (L3+P 0)**
Prerequisite: (-)
The course focuses on the definitions and constructions of various cryptographic primitives and protocols. Topics include symmetric-key encryptions, public-key encryptions, hash functions, authentications, digital signatures, and key management.

COMP 309: Multimedia Systems **2Cr.Hr (L2+P 1)**
Prerequisite:(-)
This course introduces principles and current technologies of multimedia systems. Topics include issues in multimedia applications design, multimedia data processing and representations, multimedia compression standards (Text, Image, Video and Audio), multimedia content representation, content-based multimedia retrieval, and multimedia network communications.

COMP 310: Advanced Web Programming **2Cr.Hr (L1+P 3)**
Prerequisite:COMP 206.
This course is an extension of COMP 206. It provides an introduction to Three-Tier architecture in Web development, Java Servlet, handling the client request: form data, JSP scripting elements, integrating servlets and JSP, accessing database with JDBC, java server faces and struts.

COMP 311: Declarative Languages **2Cr.Hr (L2+P 1)**
Prerequisite:(-)
This course focuses on Logic Programming Languages or Functional Programming Languages. Topics for Logic Programming Languages include basic introduction to logic programming, basic constructs of logic programming (facts, queries, the logical variable, substitutions, instances, and rules), and studying one of modern logic programming language such as Prolog. While the Topics for Functional Programming Languages include basic introduction to functional programming, *Lambda Calculus (*syntax and semantics, order and reduction systems, recursion and Lazy evaluation), and studying one of modern functional programming languages.

COMP 312: File Organization **2Cr.Hr (L2+P 0)**
Prerequisite:COMP 202, COMP 205.
The course provides a solid introduction to the topic of file structure design. Topics include file concepts, basic file operations, field and record organization, compression techniques, reclaiming space in files, record deletion, storage compaction, internal sorting and binary search, index file, multilevel indexing and B-trees.

COMP 313: Software Package **1Cr.Hr (L0+P 3)**
Prerequisite: (-)
This course provides an introduction to the use of several software packages which are useful to mathematics students. Among the packages are Maple and Mathematica for symbolic computing, and Matlab for numerical computing. The aim of the course is to provide the student with some basic skills in the use of this software without attempting complete coverage.

COMP 314: Advanced Database Systems **2Cr.Hr (L2+P 0)**
Prerequisite:COMP 207, COMP 301.
Topic includes object-oriented and object-relational database systems, distributed and multidatabase systems, database connectivity, querying databases through the Web.

Course Contents of the Physics Department

PHYS 301: Classical Mechanics **3 Cr. Hr. (L3+Sc1)**
Prerequisite: MATH211, PHYS 103
Newtonian Mechanics - Lagrangian and Hamiltonian dynamics - Central_force_motion - Dynamics of a system of particles - Motion in a noninertial reference frame - Dynamics of rigid bodies

PHYS 302: Solid State I **3 Cr. Hr. (L3+Sc1)**
Prerequisite: 202
Crystallography - Crystal vibrations -Thermal properties -Free electron Fermi gas -Electrons in a periodic potential – Semiconductors - Ferromagnetism, Paramagnetism and Diamagnetism:

PHYS 303: Electrodynamics **3 Cr. Hr. (L3+Sc1)**
Prerequisite: 203
scalar and vector potentials – gauge tranformations – Coloumb gauge and Lorentz gauge – Retarded potentals – Lineard–Wiechert potentials – dipole radiation (electric and magnetic) – Relativistic Electrodynamics - Magnetism as a Relativistic Phenomenon.

PHYS 304: Electronics (1) **3 Cr. Hr. (L3+Sc1)**
Prerequisite: PHYS 206
Diodes, Common Diode - Basic - Multipliers and Displays – Diodes- Bipolar Junction Transistors- DC Biasing Circuits- Introduction to Amplifiers- Common-Emitter Amplifiers- Power Amplifiers, Field-Effect Transistors - Amplifier - Operational Amplifiers, Additional - Tuned Amplifiers, Oscillators- Optoelectronic Devices- Discrete.

PHYS 305 : Quantum Mechanics I **3 Cr. Hr. (L3+Sc1)**
Prerequisite: MATH 202 PHYS 202
Simple harmonic oscillator- particle in a box and degeneracy -Hydrogen-like atom – Equation of motion – Central field problem –Magnetic Moment and Spins - Helium Atom.

PHYS 306: Basis of Solid State **3 Cr. Hr. (L3+Sc1)**
Prerequisite: --
Free electron Fermi gas- Electrons in a periodic potential - Crystal symmetry -Crystal vibrations- Thermal properties - Semiconductors

PHYS 307: Statistical Physics **3 Cr. Hr. (L3+Sc1)**
Prerequisite: PHYS 232
Macroscopic vs microscopic – ideal gas- Kinetic theory of gases– principle of equipartition of energy – classical theory of specific heat - Classical Statistical Physics - Quantum Statistical Physics- Bosons – Fermions – Bose-Einstein statistics

PHYS 308: Quantum Mechanics II **3 Cr. Hr. (L3+Sc1)**
Prerequisite: PHYS 305
Hilbert space – Observables – Hermitian operators – Dirac notations –transformations – Matrix mexhanics. - Variational Principles - Perturbations Theory- WKB Approximation - Scattering

PHYS 309: Nuclear Physics I **3 Cr. Hr. (L3+Sc1)**
Prerequisite: PHYS 202
Origins and discovery – General properties of nuclei - Nuclear radii - Nuclear force - Nuclear stability - Spin & Parity – Binding energy and semi-empirical mass formula– Natural radioactivity: General law of radioactivity / Nuclear units / Radioactive half-life / Radioactive Equilibrium Neutron reactions.

PHYS 310: Optics I: Advanced Optics, Magneto- Electro-Optics **3 Cr. Hr. (L3+Sc1)**
Prerequisite: (-)
Basic laws of electromagnetic theory - Electromagnetic waves - Nonconducting media - Energy and momentum – Radiation - The Fresnel laws of reflection and refraction - Photons and the laws of reflection and refraction - Polarization of electromagnetic light waves - Optical activity and double refraction - Faraday effect - Cotton-Mouton effect - Kerr effect - Pockels effect - Magneto- and electro-optics materials

PHYS 311: Basis of Nuclear Physics **3 Cr. Hr. (L3+Sc0)**
Prerequisite: --
Natural radioactivity: General law of radioactivity - Nuclear units - Radioactive half-life - Radioactive Equilibrium – Types of radioactive decay – Interaction of radiation with matter: Charged particles - Photons – Neutron reactions – Some of nuclear detectors: Gas filled detectors - Scintillation detectors - semiconductor detectors – Applications

PHYS 312: Theory of relativity **2Cr. Hr. (L2+Sc0)**
Prerequisite: PHYS 202 – MATH 202
Einstein's Postulates - Time Dilation, Length Contraction - Lorentz Transformation - Relativistic Effects and Paradoxes - Relativistic Invariants and Four-Vectors - Relativistic Momentum, Energy, and Mass - Relativistic Particle Collisions - Relativity and Electricity.

PHYS 314: Mathematical physics (1) **3 Cr. Hr. (L3+Sc1)**
Prerequisite: (-)
Series method- Legendre's equation- Rodrigues's formula - Generating function for Legendre's polynomials - Orthogonality of Legendre's polynomials - Normalization of Legendre's polynomials - Legendre's series - The associated Legendre's function - The method of Frobenuis - Bessel's equation - The second solution of Bessel's equation - Recurssion relations - Other kinds of Bessel function - Spherical Bessel functions - Hermite functions - Laguerre functions

Prerequisite: PHYS 202
One Dimension Quantum Mechanics - Two and three dimensions - Magnetic Moment and Spins - Helium Atom: Approximate solution and ground state – Identical Particles – Execlusion Principle – account on Multielectron atoms, Hartree theory, ground states of multielectron atoms and the periodic table.

PHYS 316 : Introduction to Astronomy 3Cr (L3+Sc1)
Prerequisite:
Greek Astronomy - Full Kepler Orbit Problem - Introduction to Electromagnetic Waves - Doppler Effect - Reflection, Refraction - The Milky Way - Neutron Stars, Supernovae, and Black Holes - Galaxy Types - Age and Large Scale Structure of the Universe - Newtonian Cosmology - Thermal History of the Universe.

PHYS 322 : Renewable energy Solar energy 3Cr (L3+Sc1)
Prerequisite: (-)
Introduction to renewable energy, Photovoltaic (PV) -Solar Cell Applications -Optical engineering - Cost analysis and environmental issues - Thin film solar cells

PHYS. 324 Kinetics of Phase Transformations 3Cr (L3 +Sc1)
Prerequisite: (-)
Fundamental principles of thermodynamics -Introduction to surfaces and interfaces. - Material transport by diffusion - Phase transformations. Homogeneous nucleation of solidification. The Turnbull experiments. Heterogeneous nucleation of solidification.

PHYS 326: Crystallography and its Applications 3Cr (L3+Sc1)
Prerequisite: (-)
Classification of materials- Method of X-ray production - lattice-crystal systems symmetry, lattice directions and planes, Miller indices - Diffraction of x-ray- Crystal structure-Computerized search-match, Order-disorder determination

PHYS 327 Semiconductor Technology 3Cr (L3+Sc1)
Prerequisite: (-)
semiconductor physics - diodes, solar cells and transistors. Technology topics comprise oxidization, diffusion, ion implantation, photolithography, film deposition - Bipolar Transistor Technology - structural tradeoffs in optimizing performance.

PHYS 331 Electrodynamics 2 Cr (L2+Sc1)
Prerequisite: PHYS 203
Gauss'law, Poisson's and Laplace equations, boundary value problems, Green's functions, image charge method - Legendre and associated Legendre polynomials - dielectric media - Faraday's law of induction, Maxwell equations in vacuum and media, the scalar and vector potentials, gauge transformations, wave equation, electromagnetic energy densities and Poynting's theorem - special relativity and the Lorentz group,

PHYS 332 : Optical Interferometry 3Cr (L3+Sc1)
Prerequisite: (-)
optical interferometry theory – testing optical surfaces, interference spectroscopy - Fourier-transform spectroscopy - fringe-counting, heterodyne and digital interferometry, fiber-optic interferometry - nonlinear interferometry.

PHYS 334 : Holography 3Cr (L3+P0)
Prerequisite: (-)
The wavefront reconstruction problem - The Gabor and Leith-upatnieks holograms - Image locations and magnification - Different types of holograms - Thick holograms - Recording materials - Computer-generated holograms - Degradations of holographic images - Applications of holography

PHYS 336: Fourier Optics 3Cr (L3+Sc1)
Prerequisite: (-)
Fourier analysis in two-dimensions - Scalar diffraction theory - Fresnel and Fraunhofer diffraction - Wave-optics analysis of coherent optical systems - Frequency analysis of optical imaging systems - Wavefront modulation - Fundamentals of Light Microscopy -Optical Contrasting of Microstructures - Raman Microscopy - Infrared Microscopy

PHYS 337 Introduction of Solid State 2Cr (L2 +Sc1)
Prerequisite: PHYS 203
fundamental concepts of condensed matter - crystal binding and elastic constants, crystal vibrations and thermal properties, free electron theory - electron in periodic potentials, - basic semiconductors - Fermi surfaces - plasmons, polaritons and polarons, optical processes and excitons.

PHYS 339: Advanced Optics 2Cr (L2 +Sc1)
Prerequisite: PHYS 204
Propagation of electromagnetic waves of light at the boundaries of different media and its applications - Introduction to interaction of light with matters, polarization and scattering - Magneto- and Electro-optic effects and materials used as shutters in Q-switching lasers, Maxwell electromagnetic wave theory and their advanced optical devices and systems.

PHYS 342 : Radiation Protection and Safety 3Cr (L3+Sc1)
Prerequisite: (-)
Quantities and measurements - Biological effects of ionizing radiation - Principles of radiation protection - Regulatory control - external and internal exposures - Medical exposures in diagnostic radiology, radiotherapy and nuclear medicine

PHYS 344 : Advanced Nuclear Techniques
Radiation sources
Radiation interactions - Gas filled detectors - Scintillation detectors - Semiconductor diode detectors - Solid state detectors - Neutron detectors - Diamond detectors - Solid state nuclear track detectors

PHYS 346 : Nuclear Materials 3Cr (L3+Sc1)
Prerequisite: (-)
types of reactor - Crystal structure of solids - Diffusion in solids - Elastic behavior of solids - Mechanical properties of metals - Cavities in solids - Fission product behavior in nuclear fuel - Polycrystalline solids - Radiation damage in metals

PHYS 352: Electronic Instrumentation & Measurements 3Cr (L3+Sc1)
Prerequisite: (-)
Different Types of Ammeters and Voltmeters, Watt meters and Energy Meters, Potentiometers and Instrument Transformers, Resistance Measurement, Impedance Measurement.

PHYS 354 : Renewable Energy Systems 3Cr (L3+Sc1)

PHYS 354 : Renewable Energy Systems 3Cr (L3+Sc1)
Prerequisite: (-)
Introducing Renewable Energy, Solar Thermal Energy, Solar Photovoltaics, Bioenergy, Hydroelectricity, Tidal Power, Wind Energy, Wave Energy, Geothermal Energy, Integration

PHYS 356 : Selected Topics 3Cr (L3+Sc1)
Prerequisite: (-)
Superconductivity, Plasma Systems, Metrology, MATLAB, Modeling and Simulation in physics, Optical Communication.

PHYS 358: Nuclear Physics 2Cr (L2+Sc1)
Prerequisite: PHYS 315
nuclear radiations - n-p scattering cross section transition probability - binding energy and nuclear stability; interactions of charged particles - with matter; radioactive decays;

PHYS 360: Statistical Physics 2Cr (L2 +Sc1)
Prerequisite: STAT 234
statistical concepts - Kinetic theory of gases - Classical Statistical Physics - Quantum Statistical Physics

PHYS 361: Experimental Physics (V) 2 Cr. Hr. (L0+P4)
Prerequisite: PHYS 208

Selected topics in material science

PHYS 362: Introduction to Solid State (for biophysics) 2 Cr (L2+Sc0)
Prerequisite: PHYS 211
classical and quantum models of electrons and lattice vibrations - crystal lattices, electronic energy band structures, phonon dispersion relatons, effective mass theorem- band structure - Dynamics of Bloch electrons, Bloch-Boltzmann semiclassical transport theory, Magnetotransport and the Hall Effect, Quantum transport in nanostructures

PHYS 363 Crystal Growth and crystallography (for biophysics) 3Cr (L2+P3)
Prerequisite: (-)
Introduction to various crystal growth techniques - Classification of growth processes, Kinetics of growth-nucleation- Crystal structures of Metals - Coordination in ionic compounds – Imperfections- mass spectrometry, emission spectrography. Fundamental understanding of protein crystallography.

PHYS 364: Electyronics 2 Cr (L2+Sc1)
Prerequisite: PHYS 337
Introduction - AC vs DC Electricity - Rectifier Diodes Circuits - Zener Diodes - Passive Filters - RLC Filters - Active Filters - OpAmp Amplifier - Design An Audio Amplifier

PHYS 366: Experimental Physics (VI) 2 Cr. Hr. (L0+P4)
Prerequisite: PHYS 361
Selected topics in electronics

Prerequisite: (-)
Introducing Renewable Energy, Solar Thermal Energy, Solar Photovoltaics, Bioenergy, Hydroelectricity, Tidal Power, Wind Energy, Wave Energy, Geothermal Energy, Integration

PHYS 356 : Selected Topics 3Cr (L3+Sc1)
Prerequisite: (-)
Superconductivity, Plasma Systems, Metrology, MATLAB, Modeling and Simulation in physics, Optical Communication.

PHYS 358: Nuclear Physics 2Cr (L2+Sc1)
Prerequisite: PHYS 315
nuclear radiations - n-p scattering cross section transition probability - binding energy and nuclear stability; interactions of charged particles - with matter; radioactive decays;

PHYS 360: Statistical Physics 2Cr (L2 +Sc1)
Prerequisite: STAT 234
statistical concepts - Kinetic theory of gases - Classical Statistical Physics - Quantum Statistical Physics

PHYS 361: Experimental Physics (V) 1 Cr. Hr. (L0+P4)
Prerequisite: PHYS 208

Selected topics in material science

PHYS 362: Introduction to Solid State (for biophysics) 2 Cr (L2+Sc0)
Prerequisite: PHYS 211
classical and quantum models of electrons and lattice vibrations - crystal lattices, electronic energy band structures, phonon dispersion relatons, effective mass theorem- band structure - Dynamics of Bloch electrons, Bloch-Boltzmann semiclassical transport theory, Magnetotransport and the Hall Effect, Quantum transport in nanostructures

PHYS 363 Crystal Growth and crystallography (for biophysics) 3Cr (L2+P3)
Prerequisite: (-)
Introduction to various crystal growth techniques - Classification of growth processes, Kinetics of growth-nucleation- Crystal structures of Metals - Coordination in ionic compounds – Imperfections- mass spectrometry, emission spectrography. Fundamental understanding of protein crystallography.

PHYS 364: Electyronics 2 Cr (L2+Sc1)
Prerequisite: PHYS 337
Introduction - AC vs DC Electricity - Rectifier Diodes Circuits - Zener Diodes - Passive Filters - RLC Filters - Active Filters - OpAmp Amplifier - Design An Audio Amplifier

PHYS 366: Experimental Physics (VI) 1 Cr. Hr. (L0+P4)
Prerequisite: PHYS 361

Selected topics in electronics
PHYS 371 Laser Physics and technology 3Cr (L3 +Sc1)
Prerequisite: (-)
Rate equations for continuous-wave and pulsed lasers, Gaussian beams, and resonators. - as laser stabilization- optical properties of crystals and semiconductors, - semiconductor

detectors, stimulated emission and population inversion, diode laser - techniques and instrumentation for laser spectroscopy.

PHYS 376 Electronic Integrated Circuits (for biophysics) 2Cr (L2+P0)
Prerequisite: (-)
Advances in signal processing- stability of feedback, frequency compensation, multistage operational amplifiers - design project to meet a required product specification. - design of an advanced CMOS op-amp and of high-performance CMOS comparators

PHYS 380: Atomic and Molecular Physics 2Cr. Hr. (L2+Sc1)
Prerequisite: PHYS 355
principles of atomic and molecular physics - the energy level schemes of atoms and molecules - rotational, vibrational and electronic molecular spectra- Dirac model, Lamb shift, hyperfine interaction, spin-orbit coupling schemes, Zeeman effect, central-field model, Born-Oppenheimer approximation, - Hund's rules - Raman scattering - magnet and optical trapping techniques.

PHYS 382 Optical Communication 2 Cr (L2+Sc1)
Prerequisite: PHYS331
transmission of data along fiber optic cabling - transmission of telecommunication signals. - electromagnetic interference - types of fiber, light source, transmitters, receivers, repeaters, amplifiers.

Course contents of Biophysics

BIOP 301 Molecular biophysics (1) 3 Cr. Hr. (L2+ P3)
Prerequisite: BIOP 211
Principles of chemical and mechanical equilibrium of biomolecular systems- Basic concepts of statistical thermodynamics to analysis biomolecular systems- Physical understanding of the structure of biomolecules- Thermodynamic view to estimate biomolecule - Relative contributions of convective and diffusive processeson the structure and motion of biomolecules. Mechanics of biomolecular deformations.

BIOP 302 Basis of Nuclear physics and radiobiology 3Cr.Hr. (L2+P3)
Prerequisite: BIOP 201
General properties of nuclei– Natural radioactivity– Types of radioactive decay – Interaction of radiation with matter– Some of nuclear detectors - Biological effects of radiation, personal radiation dosimeter, internal and external radiation safety, evaluation of radiation safety measure, radiation shielding materials

BIOP 311 Bio-statistics 2 Cr.Hr. (L2+P1)
Prerequisite: (-)
Introduction, Kinds of biological data, Probability, The mathematical basis of the statistical tests (G-test, t- test), Dispersion, Standard error, Confidence limits.

BIOP 312 Bioelectronics 3Cr.Hr. (L2+P3)
Prerequisite: (-)
Diodes and applications: p-n junction diode, Zener diodes, Half-wave diode rectifier, Ripple factor, Full-wave diode rectifier, Other full-wave circuits- Transistors: Biasing methods- Amplifiers & Oscillators- operational amplifiers- communications systems- Digital logic

BIOP 313 Bases of Biophysics (for Entomology) 3 Cr.Hr. (L2 + P3)
Prerequisite: (-)
The structure and dynamics of biological macromolecules. After introducing the necessary nomenclature and reviewing thermodynamic principles, modern techniques to characterize the structure and dynamics of biopolymers is the focus. Sedimentation, electrophoresis, mass spectrometry, X-ray diffraction, scattering, and spectroscopic techniques such as absorption, circular dichroism, fluorescence, and NMR are covered. Both physical principles and practical applications in the Life Sciences are highlighted.

BIOP 321 Principles of Genetic Engineering 2Cr.Hr. (L2+P0)
Prerequisite: BIOC 201
Structure of biological molecules, DNA enzymes, DNA polymerization, Structure of genes, Principal of genetic engineering, Gene therapy.

BIOP 322 Biophysical Techniques in Diagnosis and physical therapy 2Cr.Hr. (L2+P0)
Prerequisite: (-)
Conventional x-ray diagnosis, CT, Fluoroscopy, MRI, Ultrasound, Nuclear Medicine Imaging - Heat and cold in therapy, Application of non-ionizing and ionizing radiation in diagnosis - Application of high energy x-ray, Gamma rays, Microwave hyperthermia, Application of laser in surgery

BIOP 331 Electrodynamic and its biological applications 2Cr.Hr. (L2+P0)
Prerequisite: PHYS 203 & phys 210
Electrostatics- Special Techniques- Electric Fields in Matter- Magnetostatics: Magnetic Fields in Matter-Nonlinear Effects of Electromagnetic Fields on Whole Organisms, Living Tissues and Tissue Preparations- Nonlinear, Nonequilibrium Aspects of Electromagnetic Field Interactions at Cell Membranes - Use of Bone Cell Hormone Response Systems to Investigate Bioelectromagnetic

BIOP 332 Human anatomy 3 Cr.Hr. (L2 + P3)
Prerequisite: ZOOL 222
Anatomical terms, anatomical positions in human, human skeletal system, human muscular system, joints, nervous system, muscles of mastication.

BIOP 342 Biophysics of Hearing and Vision 2 Cr.Hr.(L2+P0)
Prerequisite: PHYS 102
Sound wave, ear structure, outer ear structures and ear's preamplifier, auditory canal resonance, the ossicles vibration and lever action, place theory, the perception of pitch according to the place theory, the perception of loudness, the auditory nerve, the auditory area of brain, sensitivity of human ear, hearing mechanism, dynamic range of hearing, hearing loss, hearing aids - Over view of vision, the visual system, geometric optics of human eye, photoreceptors, molecular mechanism of vision, theory of color vision, electroretinogram.

BIOP 351 Biotechnology 2 Cr.Hr.(L2+P0)
Prerequisite: (-)
Chemical context of life, Recombinant DNA, Cloning, Synthesis of human insulin, Gene therapy, Gene therapy for cancer, Artificial retina, Liposome as a drug delivery, Gene machine, Bioreactor.

Course Contents of Zoology Department

ZOOL 301: Conservation Biology **2Cr.Hr. (L2+P 0)**
Prerequisite: (-)
This course deals with a newly emerging topic. It represents a fusion of theory, basic research, applied research, and public education. It discusses the economic, medical, and ecological importance of protecting wild plant and animal species, the direct and indirect economic values of biological diversity, the causes of the process of extinction of animals today, the vulnerability of different animal species to extinction, establishing protected areas, designing and managing protected areas, restoring the environment, and conservation legislation.

ZOOL 302: Developmental Biology **3 Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL 202
Phases of embryogenesis: gametogenesis (spermatogenesis and oogenesis), fertilization, cleavage (the division of cells in the early embryo), gastrulation (the single-layered blastula is reorganized into a trilaminar "three-layered" structure known as the gastrula), determination of organ rudiments and embryonic induction, the process by which the ectoderm, endoderm, and mesoderm develop into the internal organs of the organism (organogenesis). The early embryonic development of mammals.

ZOOL 303: Animal Ecology **3 Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL 203
This course deals with the study of ecological interrelationships of animals at three levels: 1- Individual level, (autecology), which discusses such topics as homeostasis, interaction of environmental factors, ecological indicators, and examples of some important limiting factors. 2- Population level (synecology), which discusses some population features such as population density, age-structure, natality, mortality, mathematical treatment of exponential and logistic population growth and biotic potential, and population fluctuations. 3- Community level, which discusses such topics as community structure, chemical ecology, and biodiversity.

ZOOL 304: Molecular Genetics **3 Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL204
DNA packaging – The linear chromosome, centromere, telomeres, replication origins – Most chromosomal DNA does not code for proteins or RNA – Lampbrush chromosomes – Polytene chromosomes – Active chromatin is biochemically distinct – less condensed and highly condensed chromatin – A standard map of the banding pattern of each chromosome in the human – Transcription and regulation of gene expression in Prokaryotes - Molecular mechanisms for the regulation of gene expression at different levels in Eukaryotes (chromatin remodeling, RNA polymerases, promoters, general transcription factors, RNA processing) – Mutation – Mutagens and mutagenesis – DNA repair mechanisms.

ZOOL 305: Cell and Molecular Biology **3 Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL 102
Cell Biology: Instruments and methodologies-Chemical constituents of the protoplasm-Cell membrane-Cytoplasmic organelles (Mitochondria, Golgi apparatus, Lysosomes, Peroxisomes, Rough and smooth endoplasmic reticula,), Cytoskeleton – Cytoplasmic inclusions. Nucleus: Nuclear envelope-Nuclear lamina-Chromatin- Nucleolus-Nuclear pore complex-Other subnuclear bodies. **Molecular Biology:** Review on DNA and RNA-Recombinant DNA: DNA cloning with plasmid vectors or PCR-DNA libraries-Identification, analyzing, sequencing of cloned DNA (Membrane hybridization assay, Oligonucleotide probes, Gel electrophoresis types)-DNA biotechnology (A Brief account).

ZOOL 306: Endocrinology and Reproduction **3 Cr. Hr. (L2+P 3)**
Prerequisite: ZOOL 205
Classical definitions of hormones and endocrine glands, general nature of hormones and their interactions with other physiological regulators - Chemical classification of hormones, types of receptors and second messengers, signal transduction and molecular events in hormone mechanisms of action - Mutual hormonal effects - Interaction between nervous and endocrine systems and feedback mechanisms - Different endocrine glands: origin, subdivisions, pituitary hormones and their functions and regulation of secretion. Gonadal functions and hormonal regulation of male and female sexual activities - Ovulation, fertilization, pregnancy, implantation and formation of placenta, menopause.

ZOOL 307: Cancer Genetics **2 Cr.Hr. (L2+P 0)**
Prerequisite: ZOOL204
Principles of cancer as a genetic disease - Inherited cancer predisposition syndromes – Proto-oncogenes and tumor-suppressor genes – Oncogenic mutation affecting cell proliferation – Mutation causing loss of cell cycle control – Mutations affecting genome stability (Mutation in *p53* gene, Some human carcinogens cause mutation in *p53* gene, Defects in DNA repair systems, Chromosomal anomalies in human cancer, Telomerase expression contributes immortalization of cancer cells) – Epigenetics, Micro RNAs and cancer – DNA tumor viruses.

ZOOL 308: Advanced Invertebrates **3 Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL 201
Advanced Invertebrate Zoology is designed as an extension of Systematic Diversity in Invertebrates (201Z) to assess the essential features of all recognized invertebrate phyla (major and minor). An evolutionary approach has been adopted which provides the students with a better understanding of invertebrate diversity and phylogenetic relationships based mainly on morphological data. Moreover, recent approaches to the subject of phylogenetic analysis will be provided. Reading will focus on current research literature. Laboratory and field experiences to sites along the Red Sea and Mediterranean will add to the student's practical understanding.

ZOOL 309: Circulation and Immunology **4 Cr. Hr. (L3+P3)**
Prerequisite: ZOOL 210
Haematology and Hemodynamics: haematopoiesis, anaemia, platelets' aggregation and blood coagulation, fibrinolytic system and naturally-occurring anticoagulants, haemostasis disorders. Functional components of circulatory system, heart sounds, cardiac cycle and cardiac output, conduction system of the heart and ECG, blood flow, blood pressure and regulation. **Immunology:** innate and adaptive immunity, lymphocyte traffic, MHC molecules and antigen presenting cells, dendritic cell/T-cell interaction, defence against infectious organisms and tumour, parasites evasion mechanisms, immunological tolerance, transplantation and graft rejection, immunodeficiency diseases, allergy and autoimmunity.

ZOOL 310: Economic Zoology **2 Cr.Hr. (L1+P 2)**
Prerequisite: ZOOL 201, 202
Economic Zoology is a sort of applied zoology, which involves the study of animals that are of benefit or those that cause harm to humans. So, it is a specialized branch of zoology which deals with animal world that is associated with the economy, health, and welfare of humans. This course deals with the study of the economic importance of different invertebrates and vertebrates groups which - in a broad sense - can be categorized under following divisions: animals for food and products, economically harmful animals, animals of aesthetic importance, and animals used in scientific research

ZOOL 311: Neurophysiology (For biophysics students) **2 Cr. Hr. (L2+P0)**
Prerequisite: ZOOL 222
General organization of the nervous system, classification and functions of neurons and glial cells - Electrical activity in nerve fibres, ion gating, RMP, action potential, coding for stimulus strength, refractory periods, conducting of impulses, electrical and chemical synapses, types of neurotransmitters in the CNS and chemically regulated gates, EPSP, IPSP, synaptic integration - The brain: structural plan and functions of cerebrum, diencephalons, midbrain, hindbrain, EEG - Spinal cord, types of descending and ascending tracts, somatic division, autonomic division organization, control of involuntary effectors - Types of sensory receptors, vision, hearings, touch, taste, and smell

ZOOL 312: Principles of Endocrinology and Reproduction **2 Cr. Hr. (L1+P2)**
Prerequisite: ZOOL 205
The course covers the endocrine system and its hormonal secretion, including the hormone producing cells, synthesis and modification of the hormones, release and transport of the hormones, hormone receptors and the mechanisms of hormone action, the effects of hormones on target cells, the effects of hormones on physiological processes, as well as the diseases caused by inappropriate hormone functions - Gonadal functions and hormonal regulation of male and female sexual activities- Ovulation, fertilization, pregnancy, implantation and formation of placenta, menopause.

ZOOL 314: Natural Resources **1 Cr.Hr. (L1+P 0)**
Prerequisite: (-)
This course deals with the study of some important renewable resources such as fresh water, grass land, food (including fish), soil, and wild plant and animal resources. It focuses on some important problems correlated with natural resources such as contamination of fresh water resources, overgrazing, hunger and poverty, increasing world food production, and soil erosion and conservation. The course discusses the proper solutions of such problems. It also deals with different approaches to the sustainable use of natural resources.

ZOOL 320: Immunization and Immunotherapy **1 Cr. Hr. (L1+ P0)**
Prerequisite: ZOOL 205
Differences between virulence and antigenicity - How the virulence can be attenuated - Induction of active and passive immunization - Use of conjugate vaccines and adjuvants - Childhood vaccination schedules - Diseases for which effective vaccines are not yet available - Immunmodulators and cytokines therapy - Immunosuppressive drugs - Cells based immunotherapy - Allergen immunotherapy.

ZOOL 322: Physiology (1) **4 Cr. Hr. (L3+P3)**
Prerequisite: ZOOL 101
Nutrition and Metabolism: calories, factors affecting the metabolic rate, nutritional requirements, obesity and slimness, carbohydrate, lipid and protein metabolism.
Haematology and Hemodynamics: haematopoiesis, blood coagulation, fibrinolytic system and naturally-occurring anticoagulants, haemoglobin and gas exchange/transport, functional components of circulatory system, cardiac cycle, ECG and arrhythmias, blood flow, blood pressure and regulation.
Immunology: immune cells, innate and adaptive immunity, defence against infectious organisms and tumour, immunization, immunological tolerance, transplantation and graft rejection, immunodeficiency diseases.

ZOOL 326: Advanced Invertebrates and Protozoology **4Cr.Hr. (L2+P 2)**
Prerequisite: ZOOL 201
Advanced Invertebrates: Students will demonstrate an advanced understanding of the diversity of invertebrate phyla. This course will include comparative morphological, internal structures and phylogenetic relationships of individual phyla. Laboratory skills will be focused on diversity and comparative structure. **Protozoology:** General biology, ecology and classification of the Protozoa. Structure and ultrastructure of protozoan nuclei and organelles, and recent theories explaining their functions. Reproduction and morphogenesis. Life cycle patterns of the main protozoan groups and their biological importance.

ZOOL 328: Advanced Invertebrates and Parasitology **3 Cr.Hr. (L2+P2)**
Prerequisite: ZOOL 201
Advanced Invertebrates: Students will demonstrate an advanced understanding of the diversity of invertebrate phyla. This course will include comparative morphological, internal structures and phylogenetic relationships of individual phyla. Laboratory skills will be focused on diversity and comparative structure.
Parasitology: Definitions of terms, animal associations, habitats of parasites and factors affecting their distribution. Types of life cycles in parasitic infections, host-parasite relationships, zoonoses, host specificity. Examples of some pathogenic parasites causing diseases including Protozoa, Trematoda, Cestoda, Nemaloda, Acanthocephala, and Arthropoda.

ZOOL 329: Principles of Haematology and Immunology **3 Cr. Hr. (L2+P3)**
Prerequisite: ZOOL 205
Haematology: the course in Haematology is divided broadly into three main areas namely: general Haematology, blood group-serology (Immunohematology), and haemostasis.
Immunology: the course introduces the principles of immunology including development of the immune system, cells of innate and adaptive immunity, lymphocyte traffic, immunoglobulins rearrangement and diversity, antigen-antibody interaction, MHC molecules and antigen presenting cells, T-cell receptors, dendritic cells, T-cell activation and effector functions, cytokines, immune responses to infectious organisms and tumours, NK cells, T-regulatory cells and immunological tolerance, immunodeficiency diseases.

ZOOL 330: Selective Topics **2 Cr. Hr. (L2 + P0)**
Prerequisite: (-)
This course explores the current advances and progress in the field of Invertebrates and Parasitology in its broadest sense. The topic and contents will be announced periodically each time the course is presented. The course objective is to provide novel information in one or more of the particular areas that may be of interest to the students to expand their knowledge.

ZOOL 331: Selective Topics **2 Cr. Hr. (L2 + P0)**
Prerequisite: (-)
This course explores the current advances and progress in the field of Comparative Anatomy, Embryology and Animal Ecology in its broadest sense. The topic and contents will be announced periodically each time the course is presented. The course objective is to provide novel information in one or more of the particular areas that may be of interest to the students to expand their knowledge.

ZOOL 332: Bases of Zoodiversity (for minor biology) **2 Cr. Hr. (L1 + P2)**
Prerequisite (-)
This course deals with: What is zoodiversity? How is it perceived, valued, measured, monitored, and protected? What are various strategies for protecting zoodiversity while also meeting human needs? What are current perspectives from evolutionary and community ecology, conservation biology, environmental anthropology, political ecology, and ecological economics? What can we learn from case studies, and what is the role of science for building more effective on-the-ground strategies?

Course Contents of the Entomology Department

ENTM 301 Advanced Insect Ecology **2Cr.Hr. (L1+P3)**
Prerequisite: ENTM 205

1. Introduction.
2. Components of the environment and their effects on an insect chance to survive develop and reproduce: Weather factors (temperature - moisture – light), Food, Biodiversity, gene banks and bionomics.
3. Diapause phenomenon in insects: types of diapause and life cycles - intensity of diapause - factors inducing or terminating diapause - importance of diapause.
4. Molecular population genetics of insects: molecular DNA sequence variation - frequency distributior of DNA polymorphism - levels of nucleotide heterozygosity.
5. Analysis of population parameters.

ENTM 302 Economic Entomology **3Cr.Hr. (L2+P2)**
Prerequisite: ENTM 204 or ENTM 209 or ENTM 201

1. Introduction
2. Economic pests:
   - Importance of insects to man: Commercial products derived from useful insects (silk - honey – bees - wax - shellac-cochineal and other dyes), Insect predators and parasites "examples", Insects as (pollinizers, soil builders, subjects for scientific study, food of man and animals and as scavengers).
3. Pests attacking cotton, sugar-cane, corn, leguminous plant crops, fruit trees, stored grains and their products and vegetables.

ENTM 303 Insect taxonomy 2 **3Cr.Hr. (L2+P3)**
Prerequisite: ENTM 209
Levels of taxonomy:

1. Alpha: Identification of insect species by different methods
2. Beta: Classification of insect categories (10 categories)
3. Gamma: Names and problems solution

ENTM 304 Entomological aspects based on genetic principles **3Cr.Hr. (L2+P2)**
Prerequisite: ENTM 102 or ENTM 205

1. Cell cycle and cell division
2. Chromosomes
3. Mendel law of heredity
4. Chromosome aberrations
5. Mutation
6. Gene mapping (Eg. Linkage map).
7. Cytoplasmic Inheritance.

ENTM 305 Medical and Veterinary Entomology **4Cr.Hr. (L3+P3)**
Prerequisite: ENTM 210 or ENTM 221or (ENTM 252& 255)

1. History and definitions in Medical Entomology.
2. Routes of disease transmission.
3. Systematics, Biology and Ecology of medically and veterinary important insect groups.
4. Arthropod-borne diseases directly caused, or transmitted by insects.
5. Life cycle of the pathogen/parasite within both the insect vector and vertebrate host.

ENTM 306 Insect Embryology2Cr.Hr. (L1+P2)
Prerequisite: ENTM 203

1. Embryonic development in insects: the structure of the egg - entrance of sperm – maturation division of the nucleus - cleavage and blastoderm formation - the germ band and the primary dorsal organ - the embryonic envelops (amnion and serosa) - gastrulation and formation of the inner layer - segmentation - blastokinesis - mouth parts development.
2. Formation of the digestive system, nervous system, cuticle, tracheae, heart, gonads and muscles.

ENTM 307 Insect Communication **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

Forms of communication between insects

1- Contact "tactile" communication.
2- Acoustic communication.
Methods of production and perception of sound.
3- Visual "optical' communication. (Passive and active signals.)
4- Chemical communication. (Allelochemicals and pheromones.)
5- Advantages and disadvantages of each method.

ENTM 308 Use of Insects in Treatment **2Cr.Hr. (L2+P0)**
Prerequisite: (-)

A. MAGGOT THERAPY
    1. Definition, History and commercial production of maggots
    2. Application and mechanisms of action
B. APITHERAPY "BEE THERAPY"
    1. Definition and History
    2. Bee products used for nutrition and treatment
C. Advantages and disadvantages of Entomotherapy

ENTM 309 Insect pests of stored grain and grain products **2Cr.Hr. (L1+P2)**
Prerequisite: (-)

1. Importance of stored grains and their products.

2. Methods of grain storage. 3. Source of infestation.
4. Major pest. 5. Minor pests.
6. Accidental pest. 7. Associated storage fungi.
8. Detection of infestation. 9. Damage.
10. Preventive and control measures.

ENTM 311 Acarology (Elective) **2Cr.Hr. (L1+P2)**
Prerequisite: (-)

1. Description oftheimportants of ticks and mites
2. Classification - External morphology - Habit and Habitat - Anatomy.
3. Hard and soft ticks control.
4. Important Families of endoparasitic, ectoparasitic and free living mites.

ENTM 312 Principles of Insect Cytogenetics **2Cr.Hr. (L1+P2)**
Prerequisite: (-)

1. Introduction. 2. Cell structure and organelles. 3. Chromosome structures.
4. The cell cycle and DNA replication. 5. Types of cell divisions (mitosis and meiosis).
6. Chromosomal rearrangement studies. 7. Extranuclear genetic system.
8. Eukaryotic transcriptional systems. 9. Plotting of chromosome maps - mapping parameters.
10. Description of the relationships between the chromosome structure and phenotype of some insects. 11. The induction of genetic changes in the karyotype of some insects as an approach of pest control (using irradiation and chemicals). 12. The value of some microscopic and molecular approaches in insect cytotaxonomy.

ENTM 313 Insect Cell Cultures **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Introduction and definitions.
2. Historical background of insect cell cultures
3. Culturing and sub-culturing of insect cells
   a) Importance of serum and serum free media
   b) Cell differentiation and proliferation.
   c) In vitro transformation of insect cells
4. Cloning of insect cells
5. Cell line preservation and characterization. 6. Safety, bioethics, and validation.

ENTM 314 Biodiversity and Protectorates **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1 hours / week for lectures, **-** hours / week for laboratory sessions, **1** credits for one term

1. Biogeography: Definition, History and Biodiversity.
2. Wild life and Wild Species Importance.
3. Examples of Alien Species.
4. Species Extinction.
5. Conservation of Natural Resources.
6. Egyptian Protectorates: Types and collected insect species.

ENTM 315 Systematic Entomology 2 **3Cr.Hr. (L2+P3)**
Prerequisite: ENTM 221

2 hours / week for lectures, **3** hours / week for laboratory sessions,**3** credits for one term

1. Introduction and nomenclature.
2. Taxonomic keys and Identification of the collected specimens.
3. Class: Insecta, Subclass: Apterygota (4 Orders and 5 Families).

4. Subclass: Pterygota: Division: Exopterygota (15 Orders and 30 Families).
5. Division: Endopterygota (9 Orders and 45 Families).

ENTM 316 Principles of Insect Ecology **2Cr.Hr. (L1+P2)**
Prerequisite: ENTM 224

1. Study the relationship between habitat durational stability, growing season length, abiotic variable,species tolerances, and generation time.
2. Modification and adaptation of insect behavior and insect physiology to the variation of environmental extremes
3. Species interaction.

ENTM 317 Insect Evolution and Population Structure **1Cr.Hr. (L1+P0)**
Prerequisite: ENTM 205 or (-)

1. Organic Evolution-Evolutionary theories.
2. Evidences of Evolution (Palentology, Taxonomy, Zoogyography, Comparative anatomy, Embryology and Genetics)
3. Geological times.
4. Insect fossils: Orders of insects as fossils
5. Variation:Non inherited variation- Inherited variation.
6. Evolutionary species concept and population structures.
7. Speciation: through geographical aspects (allopatric and sympatric speciation)

ENTM 318 Beneficial and harmful insects **3Cr.Hr. (L2+P3)**
Prerequisite: ENTM 215

1. Introduction and definitions.
2. Beneficial insects: Commercial products derived from useful insects (silk - honey - beeswaxshellac-cochineal and other dyes), Insect predators and parasites "examples", Insects as :(pollinizers, soil builders, subjects for scientific study, food of man and animals and as scavengers).
3. Harmful insects: Pests of (cotton, sugar-cane, corn, leguminous plant crops, fruit trees), Pests of stored grains and their products.

ENTM 320 Genetics in relation to insects **2Cr.Hr. (L1+P2)**
Prerequisite: ENTM 228

1. Basic principles of heredity.
2. The Mendelian and non-Mendelian modes of inheritance that govern passage of genetic traits across generation.
    a. Sex determination, sex-linked characteristics, and sex-chromosome inheritance.
    b. Quantitative genetics.
3. Molecular biology of gene expression. 4. Gene mutations and DNA repair.
5. Chromosome and sex-chromosome inheritance.
6. Genetic Linkage and eukaryotic gene mapping.

ENTM 326 Principle of Insect Embryology **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. The principle of Embryonic development in insects: the egg - maturation division of the nucleus - cleavage and blastoderm formation - the germ band formation - gastrulation and formation of the inner layer - segmentation - blastokinesis.
2. Organogenesis: the digestive system, nervous system, cuticle, tracheae, heartand gonads.

ENTM 327 Insect Evolution and Phylogeny **1Cr.Hr. (L1+P0)**
Prerequisite: ENTM 228

1. Introduction, evolution and origin of life.
2. Evidences and theories of evolution.
3. Geological times.
4. Origin of insects (Orders of insects as fossils).
5. Types of variation.
6. Speciation (allopatric and sempatric).
7. Phylogenetic tree.

ENTM 328 Insect Cell Cultures Technology **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Insect cell cultures design, layout, and equipment.
2. Importance of and progress in insect cell culture technology.
3. Biology of Cultured Cells
   a. Aseptic Technique. b. The Culture Environment.
   c. Measurement of viability and cytotoxicity.
   d. Cell Adhesion. e. Differentiation. f. Cell Proliferation.
4. Applications of insect cell culture technology.
5. Safety, Bioethics, and future of insect cell culture technology.

ENTM 331 Medical Entomology **2 Cr.Hr. (L1+P2)**
Prerequisite: (-)

1. Definition of medical entomology.
2. Relation of insects to human health.
   a. Insects as causative of disease condition
   b. Insects as vectors of diseases
3. Insect groups of medical and veterinary importance.
   a. Cockroaches, bugs, lice and fleas
   b. Gnats, c. Flies

ENTM 352 Applied Medical and Veterinary Entomology **4Cr.Hr. (L3+P3)**
Prerequisite: ENTM 255

1. Vector surveillance.
2. Vector sampling and vector incrimination.
3. Geographical Recognition (GR) using GPS and GIS-RS.
4. Handling and transportation of live arthropod specimens.
5. Keys for vector identification.
6. Laboratory colonization of vectors.
7. Dissection of insect vectors.
8. Storage of insect vectors.

ENTM 353 Insect Physiology **5Cr.Hr. (L3+P4)**
Prerequisite: ENTM 102 or ENTM 254

1. Structure, chemistry and function of the cuticle. 2. Feeding . 3. Digestive system functions and anatomical differentiation. 4. Excretion: mechanism of excretion. 5. Blood circulation and hemolymph. 6. Respiration: mechanism of respiration. 7. Nervous system. 8. Muscle contraction. 9. Reproduction. 10. Endocrine organs: hormones and pheromones and their functions.

ENTM 354 Insect Vector Behavior **2Cr.Hr. (L2+P0)**
Prerequisite: ENTM 256

1. Feeding behavior
    a. Sugar-feeding behavior
    b. Blood-feeding behavior
        i. Host-seeking and selection. ii. Anthropophily and zoophily
        iii. Endophagy and exophagy
2. Resting behavior (Endophily and exophily).
3. Dispersal and learning. 4.Sexual (mating) behavior and pheromones
5. Larval competition. 6. Seasonality and diapause
7. Circadian activity rhythms and the gonotrophic cycle.

ENTM 355 Apitherapy (Bee Therapy) **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. What is apitherapy? 2. History of apitherapy
3. Bee products used for nutrition and treatment
    a. Bee products as health foods
    b. Bee products used in apitherapy:
        i. Honey, ii. Royal jelly, iii. Pollen, iv. Propolis, v. Bees wax, vi.Bee venom
4. Bee venom therapy: Uses "What types of condition does bee venom treat"?
    c. Administration and precautions
5. Advantages of apitherapy. 6. Side effects "Possible problems or complications".

ENTM 356 Molecular Entomology **3Cr.Hr. (L2+P3)**
Prerequisite: BIOC 205

1. Genomics and post- genomics advances
2. Identification of expressed sequence tags (ESTs)
3. Control of arthropod-borne-diseases by the application of transgenic technology to vectors
4. Molecular targets in vector-pathogen interactions.
5. Molecular identification of complex species.
6. Molecular basis of Insecticide resistance.
7. Olfaction in vector-host interaction advances. 8. Proteomics.

ENTM 357 Technical skills in medical Entomology **1 Cr.Hr. (L1+P0)**
Prerequisite: ENTM 255

1. Chemical and biological hazards.
2. Laboratory safety guidelines.
3. Labelling and storage of collected insect and blood samples.
4. Identification of fresh, mounted, or cold-stored specimens.
5. Staining, dissection,histological and microscopic techniques.
6. Molecular methods for identificationof vector and pathogen/parasite.
7. Serological methods for detection of pathogen/parasite.

ENTM 358 Principles of Conservation Biology **1Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Definitions and terminology: Conservation movement, conservation ethics, environmental preservation, restoration ecology
2. Insects and biodiversity: Threats to biological diversity
3. Conservation status:The red list of endangered species, risk categories
4. Causes of endangerment: Natural causes, human activities
5. Nature and protection of biodiversity: Insect responses to change

6. Man and protection of biodiversity, conservation, preservation and restoration
7. Conservation strategies: Researching - protected areas - wildlife corridors

ENTM 359 Transmission of Plant Diseases by Insects **2Cr.Hr. (L1+P2)**
Prerequisite: (-)

1. Introduction and relationships among insects and plants
2. Adaptation of insects to phytopathogenic transmission
3. Non-microbial plant diseases
4. Bacterial diseases
5. Fungal diseases
6. Viral diseases

ENTM 360 Insects Defenses **1 Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Mechanical defenses: Autotomy – losing legs and body parts (Walking sticks)
2. Chemical defenses: Chemical nature of defensive compounds - Sources of defensive chemicals - Organs of chemical defenses - Repellency
3. Defensive methods: Induced cleaning – Adhesion - Causing pain or discomfort.
4. Protective Coloration: Crypsis – Mimesis - Warning Colors - Mimicry (Batesian mimicry, Müllerian mimicry, mimicry as a continuum)
5. Collective defenses in gregarious and social insects

ENTM 361 Maggot Therapy **1 Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. What is Maggot Therapy?
2. History and current status of maggot therapy
3. Maggots used for medical applications
4. How maggots work "Mechanisms of action"
5. Commercial production of maggots. 6. Methods of application
7. The role of maggot therapy in wound management
8. Factors that influence maggot survival within a wound
9. Advantages and disadvantages of maggot therapy

ENTM 362 Research Ethics in Medical Entomology **1 Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Effect of science on society
2. Ethical and regulatory Issues in clinical symptoms caused by insects.
3. Human and animal experimentation
4. Ethical committee, informed consent, confidentiality, human rights
5. Policies and regulations: honesty, objectivity, integrity, carefulness, social responsibility, legality, animal care, human subjects protection.
6. Ethical decision making in research.

ENTM 364 Population Dynamics **1 Cr.Hr. (L1+P0)**
Prerequisite: (-)

1. Introduction to population attributes
2. Population distribution
3. Types of population densities
4. Population regulation
5. Population dispersal
6. Factors affecting population dynamics