MATH 225: Vector analysis Tensor Calculus and Matrices 3 Cr. Hr. (L3+Sc 1)
Prerequisite: MATH 101

1.Vector differential Calculus. 2. Vector integral calculus: Line integrals - Green's theorem - Independence of path and potential theory - Surfaces in 3-dimensional space and surface integrals - The divergence theorem - The integral theorem of Stokes. 3. Tensor calculus: Four-dimensional representation of Lorentz transformation - Covariance of natural laws in four-dimensional formalism - Tensors of second rank - Tensors of arbitrary rank - Pseudo-tensors - Levi-Civita simple - Dual tensors - Tensors and Pseudo-tensors fields, Tensor analysis - 4. Matrices: Basic definition and notation –Operation on matrices- Inverse of the matrix- Eigen value problems- Solution of linear system.

MATH 227: Complex Variables 3 Cr. Hr. (L2+Sc 2)
Prerequisite: MATH 102

Complex Numbers - Functions of Complex variables - Elementary functions - Analytic functions. Complex derivatives and integrals- Cauchy Riemann equations - Harmonic functions – Cauchy integrals - Calculus of residues - Series of Complex functions (Taylor and Laurent expansions). Applications Cauchy integrals - Liouville theorem - Polynomials and their roots - Conformal mappings and their properties.

MATH 229: Vector analysis and Tensor Calculus 2 Cr. Hr. (L2+Sc 1)
Prerequisite: MATH 101

1. Vector differential Calculus. 2. Vector integral calculus: Line integrals - Green's theorem - Independence of path and potential theory - Surfaces in 3-dimensional space and surface integrals - The divergence theorem - The integral theorem of Stokes. 3. Tensor calculus: Covariance of natural laws in four-dimensional formalism -Tensors of second rank - Tensors of arbitrary rank , Tensor analysis - 4. Matrices: Basic definition and notation –Operation on matrices- Inverse of the matrix.

STAT 201: Theory Of Statistics (I) 3 Cr.Hr. (L3+Sc1)
Prerequisite: STAT 102

Generating functions (moment and factorial moment generating functions)-Some parametric univariate families of distributions-Joint distribution functions-Conditional distributions, Covariance and correlation coefficient-conditional moments and stoehatic independence. Disc crete and continuous bivariate dstribulens. Multinomial & bivariate normal distributions and their characterizations. Some other bivariate distributions.

STAT 202: Theory of Statistics (II) 3 Cr.Hr. (L3+Sc1)
Prerequisite: STAT 201

Functions of random variables and their distributions using (Cumulative distribution function technique-Moment generating function technique-Transformation technique)-Distribution of sum and difference of two random variables-Distribution of product and quotient of two random variables -Distribution of sum of squares of independent standard normal random variables-

variables -Distribution of sum of squares of independent standard normal random variables-sampling distributions: Sampling from the normal distribution-the distribution of sample mean and sample variance-T distribution and its characteristics-F distribution and its characteristics.The distribution of certain quadratic forms.

STAT 203: Statistical Methods (I) 3 Cr.Hr. (L2+Sc3)

Prerequisite: STAT 101

This course focuses on applying statistical techniques in significance tests. It covers: Descriptive statistics analysis. Testing of hypotheses – Analysis of variance (one – way and two – way analysis of variance) – Simple and multiple regressions – Tests of independence. χ^2 tests of goodness of fil, test of homogeneity, test of independence. Computer applications.

STAT 204: Probabilistic Methods in Operations Research (I) 3 Cr.Hr. (L2+Sc1.0)

Prerequisite: STAT 102

Theory of games (Concepts and definitions strategies, stable games, unstabie games – The fundamental theorems – Games with saddle points – Dominance -- Linear programming solution of rectangular games) - Network analysis (Minimal spanning tree – Shortest route through a network – Critical path method "CPM" – PERT analysis).Stochastic programming. Decision theory.

STAT 205: Statistical Mathematics 3 Cr.Hr. (L3+0)

Prerequisite: Math 102

Calculus of finite differences(the operators Δ, Δ^{-1} and E , summation of series)-Difference equations (solution of first order linear equations with constant and variable coefficients, solution of the n^{th} order equation with constant coefficients, solution of some types of second order linear equations with variable coefficients, applications)- Some special functions(gamma, beta and Bessel functions, properties, applications)- Laplace transform and its application solving difference equations, linear differential equations, integral equations of convolution type) - Some matrix theory topics (expectation, variance, and differentiation of a vector of random variables, cholesky decomposition, quadratic forms of random variables)– Orthogonal polynomials orthogonal polynomial associated with a probability distribution, Hermit and Laguerre polynomials).

STAT 206: Statistical Methods(2) 3 Cr.Hr. (L2+3Sc)

Prerequisite: STAT 203 or STAT 207.

This course focuses on applying non-parametric statistical methods.

Introduction and review (hypothesis testing, Estimation, Measurement scales, nonparametric statistics, availability and use of computer programs in nonparametric statistical analysis) - Single population inferences [location parameter (sign test-Wilcoxon signed rank test-confidence intervals), population proportion (binomial test- confidence interval), runs test for

randomness] –Two populations inferences cndependent cand relatecr ranlales [difference between location parameters : Median test – Mann-Whitney test – confidence intervals – Equality of two dispersion parameters tests Chi-Square tests of independence and homogeneity – Rank correlation and others measures of association – Logistic regression. Computer applications.

STAT 207: Statistical Laboratory (1 credit hour (L0 +2Sc)

Prerequisite: STAT 101

Providing students with the basics of descriptive and inferential statistical analysis as well as utilizing the statistical capabilities of some statistical packages. Produce statistical graphics, including scatter diagrams, and cumulative frequency polygons. Calculate parameters using the uniform, binomial and normal distributions. Develop and interpret simple and multiple regression equations and their correlations coefficients. Construct interval estimates for population means. Conduct hypothesis testing for one or two samples. Conduct simple variance testing using ANOVA F distribution principles.

STAT 208: *Principles of Regression Analysis* 3Cr. Hr. (L2+2Sc)

Prerequisite: STAT 201

This course provides a survey of regression analysis techniques, covering topics from simple regression, multiple regression, logistic regression, and analysis of variance Regre ssion Dia grostics. Poly namial Regression. Selecting the best rsg poisson oquation. Poisson regression Analysis. Focus is.

STAT 209: Concepts of Statistics for biological Curricula1 Cr.Hr.(L1+Sc1)

Prerequisite: (-)

Introduction to Biostatistics – 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, poisson approximation of Binamial Continuous probability distributions, Normal distribution, Normal approximation of Binamial Applications,) – Simple Linear Regression and Correlation.

STAT 210: Fundamentals of Statistical Methods 3 Cr.Hr.(L2+Sc3)

Prerequisite: (-)

This course provides the fundamentals of parametric and non parametric statistical methods with software applications. Parametric methods: Estimation and confidence intervals- One sample tests of hypothesis-Two Sample tests of hypothesis- Analysis of variance- linear regression and correlation-Multiple regression and muhiple correlation Analysis. Nonparametric methods: Chi- square tests Applications- Analysis of ranked data.

STAT 211: Basics of Statistics (for geological Curricula) 3 Cr.Hr.(L2+Sc3)

Prerequisite: (-)

Introduction to Statistics – 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, Application) – Simple Linear Regression and Correlation. Estimation: point estimation and interval estimation – estimation of population mean, population proportion and population variance. Tests of hypotheses: testing of population mean, population proportion and population variance– testing the difference between two population means - testing the difference between two population proportions- testing the difference between two population variances.

STAT 212: Introductory biostatistics (for Entomology Curriculum) 3 Cr.Hr. (L2+Sc2)

Prerequisite: (-)

Estimation: point estimation and interval estimation – estimation of population mean, population proportion and population variance. Tests of hypotheses: testing of population mean, population proportion and population variance– testing the difference between two population means - testing the difference between two population proportions- testing the difference between two population variances. Analysis of variance: one way analysis of variance – two way analysis of variance. χ^2 Tests: goodness of fit – contingency tables (test of independence. Applications using a statistical package.

STAT 213: Fundamentals of Statistics and Probability 3 Cr.Hr. (L2+Sc2)

Prerequisite: (-)

Descriptive study of data, Probability (the notion of probability, the axiomatic approach) (randon: experiment, sample sqace, events, probability, probability space, conditional probability), random variables and probability distributions (discrete and continues random variables, probability mass function, probability density function, distribution function), the notion of a probability model, some univariate discrete and continuous distributions, numerical characteristic of random variables(expectation, variance, higher moments),

STAT 214 : Basics of Statistics For biological Curricula 3 Cr.Hr. (L2+Sc2)

Prerequisite: (-)

Introduction to Statistics – 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, Application) – Simple Linear Regression and Correlation. Estimation: point estimation and interval estimation – estimation of population mean, population proportion and population variance. Tests of hypotheses: testing of population mean, population proportion and population variance– testing the difference between two population means - testing the difference between two population proportions-

testing the difference between two population variances. Nonparametric tests – use of statistical packages.

STAT218: Introduction to Probability For Computer Science Curricula **3Cr.Hr.(L3+Sc1)**

Prerequisite: STAT 101

Sample spaces, axioms and elementary theorems of probability, combinatorics, dependence, conditional probability, random variables, probability distributions, expectation, mean, variance, moment generating functions, Chebyshev's inequality, and limit theorems (law of large numbers, central limit theorem). Examples of stochastic processes, Markov chains, classification, entropy, interpretation of entropy, joint and conditional entropy.

STAT 221 : Introduction to time series **3 Cr.Hr.(L2+Sc2)**

Prerequisite: STAT 101

Models For time Series the analysis of time series; Editing time series data; Secular trend; periodic changes; Irregular on random fluctuations; General statement of the nature of the time series; Measurement of trend; Computing the trend when the data are given as monthly averages; Shifting the origin; Elimination of trend; Seasonal variations, The specific seasonal and the typical seasonal. ModeLs of stationary processes (ARMA, ARIMA)

STAT 222: Index numbers **2 Cr.Hr.(L2+Sc0)**

Prerequisite: (-)

Classification of index numbers; problems in the construction of index numbers; Comparison of different methods of weighing, Weighted average of price relatives; Quantity index numbers; Mathematical tests of consistency; Fixed and chain base indices, Base shifting; Splicing and deflating; Consumer price index numbers; Method of compilation of consumer price index.

STAT 223 Statistical Modeling **3 Cr.Hr.(L2+Sc2)**

Prerequisite: STAT 101

Statistical models- classes of statistical models (linear and nonlinear models- Regression models and models with classification effects- fixed, random and mixed models- Bayesian models)- estimation principles(least squares, likelihood, inference principle for survey data)- residual analysis.

STAT 224 : Introduction to statistical quality control **2 Cr.Hr.(L2+Sc0)**

Prerequisite: STAT 101

The meaning of quality; the control-chart viewpoint; scientific sampling; meanings and usage of the words defective and defect; Statistical quality control may have useful By-Products; Four

different levels of understanding statistical quality control; Nonmanufacturing applications of statistical quality control techniques Statistical process control; Setting up and operating control charts for $\bar{X}$ and R; some statistical concepts; Use of control charts to judge whether or not a constant system of chance causes is present and in interpretation of a frequency distribution.

STAT 225: Selected Topics in Statistics (1) **2 Cr.Hr. (L1+Sc2)**

Prerequisite: Department approval.

This course provides the opportunity to offer a particular or a new topic in the subject area of statistics.

STAT 228: Principles of Probability Theory **2 Cr.Hr. (L2+Sc 1)**

Prerequisite: STAT 101

Random experiment-Sample space-Events-Probability axioms-Counting techniques-Conditional probability-Independence-Mutually exclusive events-Bayes theorem-Random variables ,Distribution functions and properties-Probability generating function, Characteristic functions and applications-Markov's inequality ,types of convergence, Weak law of large numbers ,Kintchine's law of large numbers , Chebyshev's inequality and the central limit theorem-The Poisson distribution as an approximation to the binomial distribution.

STAT232: Statistics and Probability **2 Cr.Hr. (L2+Sc1)**

Prerequisite: MATH 102

Descriptive statistics and data analysis; Basic probility principles; Counting techniques; Conditional probability, independence and Bayes Theorem; Discrete random variables (binomial and poisson); Continuous random variables (exponential and normal); Joint distribution, covariance and correlation; Sampling distributions; distributions of sample mean and sample variance; Central limit theorem and law of large numbers; point estimation, interval estimation and hypothesis testing.Inferential methods for population mean, population proportion; inferential methods for comparing the means of two groups and more than two groups (ANOVA); Chi- square test for independence and goodness of fit; Linear regression. Applications in physics.

COMP 201: Design and Analysis of Algorithms **3Cr.Hr (L3 + P 0)**

Prerequisite: (-)

This course provides an introduction to the modern study of computer algorithms. Topics include properties of algorithms, complexity measures, asymptotic notations, and recurrence relations. The course also includes major algorithms design techniques such as brute force, divide and conquer, greedy and dynamic programming and how to apply these techniques to solve a variety of practical problems such as sorting, searching, selection, and graph. Also, the course provides the basic concepts on the complexity classes P and NP.

COMP 202: Data Structure **3Cr.Hr (L2+P 2)**

Prerequisite: COMP 104.

This course introduces the fundamental methods of representing data in memory to design efficient algorithms for some kinds of problems. Topics include the abstract data type and implementations for arrays, linked lists, stacks, queues, trees, graphs, heaps, and hash tables. Also the course provides the applications of data structures on different kinds of problems such as evaluation of expression, expression tree, the implementation of breadth-first traverse, and compiler.

COMP 203: Theoryof Computation **2Cr.Hr (L2 +P 0)**

Prerequisite: (-)

The course provides foundations of theory of computation and a study of abstract computing devices. Topics include a primitive programming language, class of primitive recursive functions, numbering of computable function, Turing machines, computability, (semi-)decidability, universal Turing machines, Church-Turing thesis, halting problem, reduction and undecidability proofs, examples; Complexity: run time, space, complexity classes, non-determinism and NP, polynomial reductions and NP completeness, optimisation problems and approximation, randomisation

COMP 204: Computer Networks **3Cr.Hr (L2+P 2)**

Prerequisite:(-)

This course primarily aims to acquaint the student with basic computer and communication networking technologies and the layered approach that makes design, implementation and operation of computer and communication networks possible. Topics includethe structure, components and types of computer networks, packet switching,OSI and TCP/IP models. Also the topics include in details: application layer architectures and protocols, Transport layer operations, Network layer operations, Data Link layer operations,and Layer 2/3 protocols.

COMP 205: Computer Programming (2) **3Cr.Hr (L2+P 2)**

Prerequisite:COMP 104.

This course is an extension of course COMP 104.It aims to improve programming skills by using some fundamental topics not covered by COMP 104 and by using the object-oriented approach. Topics include pointers, streams and files, abstract data types, classes, objects, encapsulation, class (static) variables and functions, instance variables and functions, access modifiers (private, public, protected), object initialization using constructors, destructors, array of objects, composition, inheritance, multiple inheritance, method overriding, polymorphism, abstract classes, and unified modelling language.

COMP 206: Web Programming **3Cr.Hr (L2+P 3)**

Prerequisite: COMP 104.

This course provides a foundation to implement a full-featured Web site on the Internet, and designing and developing dynamic web pagesthat interacts with a database. Topics include a comprehensive introduction to the fundamental languages of the web today (such as HTML5, CSS3and powerful JavaScript libraries), an introduction to web programming technologies (including one or more of: Active Server Pages (ASP), PHP, Asynchronous JavaScript and XML (AJAX)) and Web databases to enhance the performance and functionality of a website.

COMP 207: Database Systems **4Cr.Hr (L3+P 2)**
Prerequisite:(-)
This course provides an introduction to design and implement database systems. Topics include designing, constructing, managing and implementing database systems and their applications, entity–relationships models (ER/EER diagrams), the relational data model, the operations of the relational algebra, relational calculus, relational database design using ER and EER-to-relational mapping, functional independencies, normal forms, structured query language (SQL) and overview of current web database warehouses and languages.

COMP 208: AutomataTheory **3Cr.Hr (L2 +Sc2)**
Prerequisite: (-)
The course provides foundations of theory of automata. Topics includeregular languages, deterministic finite automata (DFA), nondeterministic finite automata (NFA), NFA-ε machines, equivalence of DFA and NFA machines, equivalence of DFA and NFA-ε Machines, regular expressions, equivalence of regular expressions and finite state machines, closure properties of regular languages, pumping lemma for regular languages, proving non-regularity, finite state transducer (Moore -Mealy), decision problems for DFAs and regular languages, and pushdown automaton.

COMP 210: Graphs Algorithms **2Cr.Hr (L2+P 0)**
Prerequisite:(-)
The course provides a solid introduction to the theory and algorithms of graphs. Topics include fundamental definitions, concepts and facts for graphs, data structure for representing graphs, algorithms for recognizing some graphs (such as connected, Eulerian, and planner graphs), algorithms for constructing some graphs (such as minimal spanning trees, and Eulerian circuits), algorithms for determining the parameters of graphs, and some graph problems (such as matching, vertex-coloring, and edge coloring).

COMP 212: Advanced Computer Programming **3Cr.Hr (L2+P 2)**
Prerequisite: COMP 104.
This course is equivalent to COMP 205 (for double major computer science).It is an extension of course COMP 104. It aims to improve programming skills by using some fundamental topics not covered by COMP 104 and by using the object-oriented approach. Topics include pointers, streams and files, abstract data types, classes, objects, encapsulation, class (static) variables and functions, instance variables and functions, access modifiers (private, public, protected), object initialization using constructors, destructors, array of objects, composition, inheritance, multiple inheritance, method overriding, polymorphism, abstract classes, and unified Modelling Language.

COMP 214: Computer Applications **3Cr.Hr (L2+P 2)**
Prerequisite:(-).
This course provides an introduction to computers and how to solve problems using computers. The course begins with the fundamentals concepts of programming and then, shows how real-world problems can be solved computationally using one of a recent computer programming

languages such as C++, some Mathematical packages (Maple or Mathematica) for symbolic computing, or the programming language Matlab for numerical computing.

COMP 216: Introduction to Computer Applications 2Cr.Hr (L1+P 1)
Prerequisite:(-).
This course provides an introduction to computers and how to solve problems using computers. The course begins with the fundamentals concepts of programming and then, shows how real-world problems can be solved computationally using one of a recent computer programming languages such as C++, some Mathematical packages (Maple or Mathematica) for symbolic computing, or the programming language Matlab for numerical computing.

Course Contents of Physics Department - Second Level

PHYS 201: Modern Physics I 2Cr. Hr. (L2+Sc1)
Prerequisite: PHYS 102, 103
Postulates of Special Relativity - The Lorentz Transformation - Relativistic Momentum - Relativistic Energy -The Atomic Nature of Matter - The Bohr Atom - Blackbody Radiation - The Compton Effect - De Broglie's Explanation of Quantization in the Bohr Model - The Davisson–Germer Experiment - The Wave–Particle Duality -The Born Interpretation of the wave function - Expectation Values - Time independent Schrodinger equation - Energy quantization and a particle in a box of zero potential.

PHYS 202: Modern Physics II 2Cr. Hr. (L2+Sc1)
Prerequisite: PHYS 104
Central force and angular momentum – Space quantization – atomic orbits –Molecular Rotation and Vibration - Molecular Spectra - Bonding in Solids –Band Theory of Solids - Semiconductor Devices – Binding Energy and Nuclear Forces - Natural Radioactivity - Nuclear Reactions - Nuclear Fission - Nuclear Reactors - Nuclear Fusion - Radiation Damage in Matter -The Fundamental Forces in Nature – Particles and antiparticles.

PHYS 203: Electromagnetism 2Cr. Hr. (L2+Sc1)
Prerequisite: PHYS 101
Electric field (free space and matter) – Scalar Potential and Multipole Expansion -magnetic fields (free space and matter) - Vector Potential and Multipole Expansion in different coordinate systems -Maxwell's equations – modifications of Ampere's law – final form of Maxwell's equations (free space and matter)– Boundary conditions (refelction, transmission and polarization) - EM waves in vacuum– EM waves in matter – Reflection and Transmission – Absorbtion and Dispersion - Guided Waves.

PHYS 204: Physical Optics 2Cr. Hr. (L2+Sc1)
Prerequisite: PHYS102
Wave Optics -Propagation of light waves- The superposition of waves- Interference of two beams- Interference of multiple beams-Coherence-Interferometers-Fraunhofer diffraction and diffraction grating -Fresnel diffraction -Polarization of light- Polarizers, retarders and wave plates - Optical activity and double refraction-Fourier Optics - Fourier transformations- Dirac

delta function - Convolution integral -Fourier methods in diffraction theory - Spectra and correlation - Transfer functions

PHYS 205 Thermodynamics: 2 Cr. Hr. (L2+Sc1)
Prerequisite: PHYS 104
Macroscopic vs microscopic – scope of thermodynamics and relations between macroscopic quantities – thermodynamic coordinates - thermodynamic system – states and properties of the system – Energy, Heat and Work - quasi static processes – heat transfer and work done (PVT systems) – Otto cycle – Diesel Cycle – other cycles and refrigeration – Entropy, reversibility and equilibrium - Entropy change for an reversible and irreversible processes - mathematical formulation of thermodynamics – exact, inexact differentials and state variables – transformation relations and two independent variables.

PHYS 206: Electric Circuits 3 Cr. Hr. (L3+Sc1)
Prerequisite: PHYS 101
Basic ac theory – reactance and impedance (inductive)- reactance and impedance (R,L, and c) – resonance – mixed- frequency Ac signals- filters – transformers – polyphase AC circuits – power factor- AC metering circuits-methods of analysis – circuit theorems

PHYS 207: Experimental Physics (I1) 1 Cr. Hr. (L0+P4)
Prerequisite: PHYS 106
Millikan pediment (charge / mass of electron- Planck experiment – Planck body radiation – spectro photometer analysis

PHYS 208: Experimental Physics (IV) 1 Cr. Hr. (L0+P4)
Prerequisite: PHYS 207
Selected experiments in thermodynamics.

PHYS 209: Experimental Physics (I11) 1 Cr. Hr. (L0+P4)
Prerequisite: PHYS 106
Selected experiments in wave optics.

Phys 210: Computational Physics 3Cr. Hr. (L3 + P0)
Prerequisite: Phys 104
Computers and Operating Systems - Introduction to the compiler and programming - Input, Output, and Operators - Elements of Fortran - Error Analysis and Uncertainties - Methods of Data Fitting - Methods of Differentiation and Integration - Matrices and Systems of Linear Equations - Numerical Solution to ODEs - Numerical Solution to PDEs

PHYS 211: Electromagnetism and AC (for biophysics) 3 Cr (L2+P3)
Prerequisite: PHYS 101, 102, 103
Electric field in free space and matter – magnetic field in free space and matter – electromagnetic waves – alternating current circuits.

Phys 212 Electronics 2Cr. Hr. (L2 + P0)
Prerequisite: Phys 101

Fundamental solid state principles, Diodes, bipolar junction transistors, DC biasing circuits, introduction to amplifiers, common-Emiller amplifiers, Amplifier frequency response, Sinusoidal oscillator, Types of oscillator, Transsistor as crystal oscillator.

PHYS 215: Principles of Modern Physics 2Cr. Hr. (L2 + P0)
Prerequisite: Phys 102
Postulates of Special Relativity - The Lorentz Transformation - Relativistic Momentum - Relativistic Energy -The Atomic Nature of Matter - The Bohr Atom - Blackbody Radiation - The Compton Effect - De Broglie's Explanation of Quantization in the Bohr Model - The Davisson–Germer Experiment - The Wave–Particle Duality -The Born Interpretation of the wave function - Expectation Values - Time independent Schrodinger equation - Energy quantization and a particle in a box of zero potential.

PHYS 216:Introduction to electric circuits 2Cr (L1+P3)
Prerequisite:
Basic ac theory – reactance and impedance (inductive)- reactance and impedance (R,L, and c) – resonance – mixed- frequency Ac signals- filters – transformers – polyphase AC circuits – power factor- AC metering circuits.

PHYS 220: Electronics 3Cr (L3+P0)
Prerequisite:
Fundamental solid state principles, Diodes, bipolar junction transistors, DC biasing circuits, introduction to amplifiers, common-Emiller amplifiers, Amplifier frequency response, Sinusoidal oscillator, Types of oscillator, Transsistor as crystal oscillator.

PHYS 226: Physics (Electric circuits)
Basic ac theory – reactance and impedance (inductive)- reactance and impedance (R,L, and c) – resonance – mixed- frequency Ac signals- filters – transformers – polyphase AC circuits – power factor- AC metering circuits.

PHYS. 256 Introduction to Computational Physics 2Cr (L2 +Sc1)
Prerequisite: MATH 102
Computers and Operating Systems - Introduction to the compiler and programming - Input, Output, and Operators - Elements of Fortran - Error Analysis and Uncertainties - Methods of Data Fitting - Methods of Differentiation and Integration - Matrices and Systems of Linear Equations - Numerical Solution to ODEs - Numerical Solution to PDEs

PHYS 264 : Thermodynamics and electromagnetism
macroscopic vs microscopic – scope of thermodynamics and relations between macroscopic quantities – thermodynamic coordinates - thermodynamic system – states and properties of the system – Energy, Heat and Work - quasi static processes – heat transfer and work done (PVT systems) – Otto cycle – Diesel Cycle - Electric field (free space and matter) – Scalar Potential and Multipole Expansion -magnetic fields (free space and matter) - Vector Potential and Multipole Expansion in different coordinate systems -Maxwell's equations – modifications of Ampere's law.

PHYS 265 Atomic and Nuclear Physics 3Cr (L3 +P0)
Prerequisite:
Atomic structure: Atoms, Ions, and Electrons, The Nuclear Atom, The Hydrogen Atom, Optical Spectra and Electronic Structure, X-Ray Spectra. The structure of Nucleus: Nuclear constituents, Isotopes and isobar, Stable and unstable nuclides. Nuclear Models: Nuclear radii, Neutron cross-section, Liquid-drop model, Nuclear shell model, Disintegration, Radioactive decay. Production of Radioisotopes: Nuclear equations, Nuclear reaction, Reactor irradiation, Irradiation by accelerated beams, Chemically separated isotopes, laboratory neutron sources.

PHYS 266: Geomagnetic and Radiation Measurements 3Cr (L3 +P0)
Prerequisite:
Properties of radiation: Ionization, Alpha particles, Beta particles, Gamma rays, Neutrons, Cerenkov radiation.Interaction of charged particles and Electromagnetic radiation with matter: Passage of charged particles (light and heavy) through matter, Ionization, Annihilation radiation-Interaction of Electromagnetic radiation with Matter: EMR Attenuation, Compton effect, Photoelctric effect, Pair production.

PHYS 267 Principles of Atomic and Nuclear Physics 2 Cr (L2+P0)
Prerequisite:
Atomic structure: Atoms, Ions, and Electrons, The Nuclear Atom, The Hydrogen Atom, Optical Spectra and Electronic Structure, X-Ray Spectra - Nuclear structure, Natural radioactivity, laws of radioactive transformation, Alpha decay, Beta decay, interaction of radiation with matter, Accelerators of charged particles, Nuclear radiation detectors, Nuclear reactors

PHYS 268: Principles of Geomagnetic and Radiation Measurement 2Cr (L2+P0)
Prerequisite:
Interaction of charged particles with matter- Passage of charged particles (light and heavy) through matter-Ionization- Annihilation radiation- Interaction of Electromagnetic radiation with Matter- EMR Attenuation- Compton effect- Photoelctric effect- Pair production.

PHYS 274: Modern Physics
Postulates of Special Relativity - The Lorentz Transformation - Relativistic Momentum - Relativistic Energy -The Atomic Nature of Matter - The Bohr Atom - Blackbody Radiation - The Compton Effect - De Broglie's Explanation of Quantization in the Bohr Model - The Davisson–Germer Experiment - The Wave–Particle Duality -The Born Interpretation of the wave function - Expectation Values - Time independent Schrodinger equation - Energy quantization and a particle in a box of zero potential.

Course contents of Biophysics

BIOP 201: General biophysics and Waves 3 Cr. Hr. (L2+ P3)
Prerequisite: PHYS 102
Control the biological environment- mechanical properties of biological systems- transport of molecules through the cell membrane- theoretical basis of bioelectrical potential, biophysical techniques of recording biopotential and their medical application- Mechanical waves, sound waves- application of sound in medicine- electromagnetic waves- laser- solar radiation and

medical application- Acoustics and its medical applications- physical properties of infrasounds- sound and ultrasound (US) and their applications in medicine.

BIOP 202 Quantum mechanics and its biological applications 3Cr. Hr. (L2+ P3)
Prerequisite: MATH 152
Black-body- radiation- Photo-electric effect- Hydrogen atom- Wave particle duality- Uncertainty- Tunneling- Wave function- Schrödinger equation and its bio-applications.

BIOP 211 Modern Biophysics 2 Cr.Hr. (L2 + P0)
Prerequisite: PHYS 101, 103
Bohr model of the atom- Bohr Theory of H-atom- Energy level diagram- Ionization-excitation potential- Spectral series of H-atom, Quantum Numbers Principal- orbital- spin &magnetic quantum number- Orbital angular- spin angular- total angular momentum quantum number- Pauli exclusion's principle-spectra of biomolecules.

BIOP 212 Cell and membrane biophysics 2Cr.Hr. (L2+P0)
Prerequisite: (-)
Models of membrane architecture- Membrane lipids and proteins- Diffusion of water and ions through membranes- Structure of ionic channels- Transport across cellular membranes active transport- Liposome.

BIOP 213 Principle of Biophysics 2 Cr.Hr. (L2 + P0)
Prerequisite: (-)
The purpose of this course is to give an introduction to the structures, interactions, and functions of biomolecules, and in particular how they can be investigated by biophysical techniques. The physical principles of these techniques will be treated in this course, but the intention is also to indicate how they are used in practice in biomedical research and drug development.

BIOP 221 Environmental biophysics and Renewable Energy 2Cr. Hr. (L2+ P0)
Prerequisite: (-)
Atmospheric pressure and its effect on the biological organism- mechanical wave and sound pollution- mutual transfer of heat between the sun and earth and the concept of green house effect- effect of solar radiation and other non ionizing radiation on human - Introduction to renewable energy- Common forms of renewable energy- Bio Mass and Bio Fuels- Wave Energy- Marine Current Energy- Wind Energy-Geothermal-Biomass- Hydropower- Solar water heating- Carbon capture technologies (pre-combustion and post-combustion).

BIOP 222 Thermodynamics for biological systems 2Cr. Hr. (L2+P0)
Prerequisites: PHYS 104
Thermodynamic system- Process and parameters- Entropy- Gibbs free energy & enthalpy- Chemical potential energy- Transfer of heat- Body temperature regulation (by conduction-convection &radiation)- Cellular Metabolism.

BIOP 232 Physical optics and its biological application 2Cr. Hr. (L2+P0)
Prerequisites: PHYS 102

Electromagnetic Phenomena, Plane Waves and Refractive Inde- Reflection and Refraction- Multiple Parallel Interfaces- Polarization of Light- Light as Rays- Diffraction- Diffraction Applications- Microscopes and applications.

BIOP 242 Introduction to Bioinformatics 2 Cr.Hr.(L2+ P0)
Prerequisite: (-)

Application of mathematics, informatics- statistics and computer science to solve biological problems- Sequence alignment- Protein structure- Prediction of gene expression- Protein-Protein interactions- Representative problems in computational biology- DNA sequences and the prediction of gene regulation.

Course Contents of Chemistry Department - Second Level

CHEM 203: *Physical Chemistry* **3 Cr.Hr. (L2+P 3)**
Prerequisite: CHEM 101

Part 1: Chemical thermodynamics: Heat, energy, work. The first law of thermodynamics: conservation of energy, internal energy, expansion work, reversible and irreversible changes, heat capacity, enthalpy, Joule experiment, Joule-Thompson effect, isothermal gas expansion, adiabatic gas expansion. Thermo-chemistry: Hess's law, temperature dependence of reaction enthalpy, standard reaction enthalpy, standard enthalpy of formation, heat of solution. The second law of thermodynamics: the direction of spontaneous change, Carnot's cycle, efficiency of heat engine, entropy of a phase transition, variation of entropy with temperature and pressure.
Part 2: Phase equilibria: The phase rule: equilibrium, phases, components, degrees of freedom, derivation of the phase–rule. Systems of one component: the water system, polymorphism , the sulfur system, forms of ice. Two components systems: solutions of gases in liquids, liquid-liquid equilibria (completely miscible liquids, immiscible liquids, partially miscible liquids and the distillation curves). Solid-liquid systems: two components are completely miscible in the liquid state and insoluble in the solid state, two components are partially miscible in the liquid state and insoluble in the solid state, two components form a compound with a congruent melting point, two components form a compound with an incongruent melting point, two components form a continuous series of solid solutions, two components are completely miscible in the solid state and also form a compound.
Practical: Experiments related to the studied topics.

CHEM 204: Physical chemistry **2Cr.Hr. (L2+P0)**
Prerequisite: CHEM 101

Part 1: Chemical Thermodynamics: Heat, energy, work. The first law of thermodynamics: conservation of energy, internal energy, expansion work, reversible and irreversible changes, heat capacity, enthalpy, Joule experiment, Joule-Thompson effect, isothermal gas expansion, adiabatic gas expansion. Thermo-chemistry: Hess's law, temperature dependence of reaction enthalpy, standard reaction enthalpy, standard enthalpy of formation, heat of solution. The second law of thermodynamics: the direction of spontaneous change, Carnot's cycle, efficiency of heat engine, entropy of a phase transition, variation of entropy with temperature and pressure.
Part 2: Chemical kinetics: Introduction; rate of reaction, collision concept for explanation of

reaction rate, (a)activation energy (b) active collisions, rate constant. Molecularity & order of reaction, homogeneous & heterogeneous reactions, determination of order of reaction, reversible reactions, side & consecutive reactions, induction period, complex reactions, chain reactions, heterogeneous reactions theories of reaction rate.

CHEM 206: *Physical Chemistry* **3 Cr.Hr. (L2+P 3)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Electrochemistry: Introduction, theories and structure of electric double layer. Electrodes and electrochemical cells. Spontaneous electrode reactions Types of electrochemical cells, galvanic and electrolytic cells. Measuring of the electrode potential and reference electrodes. The electromotive series. Writing the Full-Cell Reactions, Measuring of the emf of a galvanic cell. Nernest equation, concentration and activity. Line Notation of Electrodes and galvanic cells. Classification of electrodes: electrodes of first type, electrodes of second type and electrodes of third type. Classifications of galvanic cells: reversible and irreversible cells, Physical, chemical and concentration cells.

Part 2: Surface Chemistry: Surface tension and surface free energy, contact angle, the equation of Young and Laplace and its experimental verification, Dupre's equation, spreading of a liquid on a substrate, phenomenon at curved interfaces (Kelvin equation), adsorption and orientation at interfaces, surface activity and Traub`s rule, thermodynamic of adsorption, Gibb`s adsorption equation (dilute solutions), Szyskowski equation (concentrated solution), surfactants: classification, properties, , liquid-liquid interface, , solid-gas and solid-liquid interfaces.

Practical: Related to the above topics.

CHEM 208: *Organic chemistry* **3 Cr.Hr. (L2+P 3)**

Prerequisite: Chem 102

Part 1: Aromatic Compounds: Aromaticity, aromatic nitro, sulfonic acids , amines , diazonium salts , phenol, aldhydes , ketones , acids and their derivatives Dinitro and diamino, di- and trihydric phenols, phenolic aldhydes and acids, aromatic dicarboxylic acids and their derivatives. Polycyclic hydrocarbons (diphenyl - diarylmethane – arylethane – flurene - naphthalene - anthracene – phenanthracene.

Part 2: Petroleum and petrochemicals: Origin and composition petroleum - refining processes. Properties of petroleum and methods of tests. Synthesis of some petrochemicals. Fraction of simple hydrocarbons.

Practical : Investigation and identification of organic compounds and simple preparation of some organic functional group compounds and their purification.

CHEM 211: (*Organic Chemistry 1*) **2Cr.Hr. (L2+P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Aliphatic Monofunctional Compounds (1): Types of isomerism , aliphatic alcohols , ethers , mercaptans and thioethers , aldhydes , ketones, mono carboxylic, acids and their derivatives (acid chlorides, acid anhydrides, esters, amides, amino acids, hydroxy acids, haloacids) and amines .

Part 2: Aromatic Monofunctional Compounds (1): Aromaticity, nitro aromatic compounds , aromatic sulfonic acids , aromatic amines , diazon- ium salts , phenol and aromatic alcohols ,

aromatic aldhydes , ketones , acids and their derivatives- nomenclature, preparation, chemical reactions and simple mechanisms.

CHEM 212: *Organic chemistry (2)* **2 Cr. Hr. (L2 +P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Aliphatic Polyfunctional Compounds (2): Dienes compounds and their relation with rubber structure – Alicyclic compounds – α , β un- saturated aldhydes and ketones - dialdhydes and diketones di- and tri carboxylic acids – ket-onic acids and esters – diethylmalonate and ethylacetoacetate and their uses in synthesis of mono acids, di-acids, mono-and di-ketones and alicyclic compounds - tautomeric isomerism.

Part 2: Aromatic Polyfunctional Compounds (2): Dinitro and diamino aromatic compounds, di- and tri-hydric phenols, phenolic aldhydes and acids, aromatic dicarboxylic acids and their derivatives. Polycyclic hydrocarbons (diphenyl- diarylmethane - arylethane -flurene - naphthalene – anthracene- phenanthracene- physical- and chemical properties- preparation and mechanisms of different reaction.

CHEM 213 : *Organic chemistry (Petrochemicals)* **1Cr.Hr (L1 + P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Petroleum: Origin of petroleum - composition of petroleum - refining processes of physical character (distillation, extraction with selective solvent , absorption and adsorption) - refining processes of chemical character (cracking). Some properties of petroleum products and methods of tests.

Part 2: Petrochemicals: Synthesis of some industrially important petrochemicals from simple hydrocarbons. Fraction of simple hydrocarbons.

CHEM 214: *Organic Stereochemistry 1*: **1Cr.Hr (L1 + P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Optical isomerism- conformational analysis - conventions used in stereochemistry correlation of configuration and specification of absolute configuration- elements of symmetry and molecular asymmetry - the number of isomers in optically active compounds- the racemic modification (synthesis, properties, resolution) -epimerisation-mutarotation- absolute and relative configurations (R and S) - asymmetric synthesis - Walden inversion- conformations and conformational analysis - stereochemistry of biphenyl compounds - absolute configuration of biphenyl - stereochemistry of allenes - Geometrical isomerism: nature and nomenclature of geometrical isomers - Determination of the configuration - stereoselective addition and elimination reaction- Interconversion of geometrical isomers.

CHEM 215: *Practical Organic Chemistry (1)* **1Cr. Hr (L0 + P3)**

Prerequisite: (Chem 101 & Chem 102)

Investigation and identification of simple solid organic compounds. Element test, effect of heat (metallic salt test), nitration (aromaticity test), effect of sodium hydroxide, effect of sodalime, acidity test (using sodium carbonate), effect of ferric chloride, solubility and reverse precipitation. Test for compounds containing (C, H, O) carbohydrates, acids and metallic salt of acids, phenols. Test for compounds containing (C, H, N, O) ammonium salt of acids, amides,

imides, amines. Test for compounds containing (C, H, N, S, halogens) amine salts. Test for functional groups (like DNP).

CHEM 216: ***Practical organic chemistry (2)*** **1Cr. Hr. (L0 + P3)**

Prerequisite: (Chem 101 & Chem 102)

Investigation using functional group tests (Molisch test for carbohydrates, sodium carbonate for acids, grinding test for ammonium salt of acids, ferric chloride for phenols, heating with sodium hydroxide test for amides and imides, Schiff's reagent for aldehydes, dinitrophenyl hydrazine for ketones, pictic acid for aromatic hydrocarbons) and identification of organic compounds via chemical reactions. Simple preparation of some organic functional group compounds and their purification.

CHEM 217: ***Organic Chemistry*** **2Cr. Hr (L2 + P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Dyes:

Nomenclature, classification -systematic study of different classes of dyes. nitro-, nitroso azo, diarylmethane, triarylmethane, xanthene, acridine, quinoline ,azines, vat and anthraquinoid. Different methodes of preparation, effect of acid and basic medium. reactions. Industrial uses

Part 2: Environmental Chemistry:

Introduction to environmental chemistry. Pollution and its kinds. Local and world problems caused by air pollution. Water pollution.

CHEM 218: ***Chemistry of Pesticides and Green Chemistry*** **2Cr. Hr. (L2 + P0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: **Chemistry of Pesticides**: Introduction – botanical insecticides – synthetic – fungicides – herbicides – fumigants rodenticides – pesticides in the environment – nematicides – future developments. Toxic chemicals in Air, water; Pesticides in water.

Part 2: Green Chemistry: Principles and basic concepts of green chemistry; water: production, problems & prevention; catalysis and green chemistry; organic solvents: environmentally benign solutions; renewable resources; designing greener processes with industrial case studies.

CHEM 222: ***Inorganic Chemistry 1*** **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 102

Part 1: Theories of Bonding: Bonding and structures MO theory for diatomic and polymeric molecules, valance balance bond theory, hybridization and molecular shapes, three-center bond model, ionic solid lattices energy, Born-Haber cycle.

Part 2: Chemistry of Non-Transition Elements: hydrogen , group I, II, III, IV , V , VI, VII elements and the Nobel gases.

CHEM 231: ***Analytical Chemistry 1*** **2 Cr. Hr. (L2+P 0)**

Principles of analytical chemistry

Prerequisite: (CHEM 101 + CHEM 102)

Overview of classical methods of quantitative chemical analysis; Methods of expressing concentrations; Types of errors in chemical analysis and statistical treatment of analytical data; Chemical equilibrium; Chemical calculations; Types of volumetric titrations including: acid-

base; oxidation-reduction, complexometric and precipitation titrations; Non-aqueous titrations and the role of solvents; Leveling effect; differentiating effect and protolysis constant of solvents; Basics of gravimetric and combustion analysis.

CHEM 232: *Analytical Chemistry* **3 Cr.Hr. (L2+P 3)**

Prerequisite: CHEM 101

(Volumetric Analysis, Gravimetric Analysis, and Non-Aqueous Titrations)

Overview of classical methods of quantitative chemical analysis; Methods of expressing concentrations; Errors in chemical analysis and statistical treatment of analytical data; Chemical equilibrium; Chemical calculations; Volumetric titrations including: acid-base; oxidation-reduction, complexometric and precipitation titrations; Non-aqueous titrations and the role of solvents; Leveling effect; differentiating effect and protolysis constant of solvents; Basics of gravimetric and combustion analysis.

Practical: Laboratory tools, glassware and simple instruments; Practice of volumetric analysis: acid-base titrations of single, and binary mixtures and monobasic, dibasic and polybasic species; direct and indirect oxidation-reduction titrations of reducing and oxidizing species; complexometric titrations with EDTA; precipitation titrations with silver nitrate; Non-aqueous titrations; Gravimetric and combustion analysis; applications for the determination of various cations and anions using inorganic and organic reagents.

CHEM 233: *Practical analytical chemistry 1.* **1 Cr. Hr. (L0+P3)**

Prerequisite: (CHEM 101 & CHEM 102)

Laboratory tools, glassware and simple instruments; Practice of volumetric analysis: acid-base titrations of single, and binary mixtures and monobasic, dibasic and polybasic species; direct and indirect oxidation-reduction titrations of reducing and oxidizing species; complexometric titrations with EDTA; precipitation titrations with silver nitrate; Non-aqueous titrations; Gravimetric and combustion analysis; applications for the determination of various cations and anions using inorganic and organic reagents.

CHEM 234: *Environmental Chemistry* **2 Cr. Hr. (L2)**

Prerequisite: (CHEM 101 & CHEM 102)

The environment and sustainability science; Chemistry and the anthrosphere; Fundamentals of aquatic chemistry; Oxidation–Reduction in aquatic chemistry; Phase interactions in aquatic chemistry; Aquatic microbial biochemistry; Overview of water pollution and treatment; The atmosphere and atmospheric chemistry; Particles, inorganic and organic pollutants in the atmosphere; Photochemical smog; Soil and agricultural environmental chemistry.

CHEM 235: *Water treatment* **2 Cr.Hr. (L2+P 0)**

Prerequisite : (CHEM 101 & CHEM 102)

Water treatment and water use; Municipal water treatment; Treatment of water for industrial use ; Sewage treatment (primary, secondary, and tertiary); Physical-Chemical treatment of municipal wastewater; Industrial wastewater treatment; Membrane filtration processes; Removal of metals, dissolved organics and inorganics, phosphorous, nitrogen, and Herbicides; Ion exchange; Electrodialysis; Reverse osmosis; forward osmosis; Desalination by thermal methods; Methods of water disinfection; Green water and water conservation.

CHEM 240: *Physical Chemistry* **2C.r.Hr. (L2+P 0)**

Prerequisite: (CHEM 101)

Part 1: Chemical Thermodynamics: Heat, energy, work. The first law of thermodynamics: conservation of energy, internal energy, expansion work, reversible and irreversible changes, heat capacity, enthalpy, Joule experiment, Joule-Thompson effect, isothermal gas expansion, adiabatic gas expansion. Thermo-chemistry: Hess's law, temperature dependence of reaction enthalpy, standard reaction enthalpy, standard enthalpy of formation, heat of solution. The second law of thermodynamics: the direction of spontaneous change, Carnot's cycle, efficiency of heat engine, entropy of a phase transition, variation of entropy with temperature and pressure.

Part 2: Electrochemistry: Electrode reversible process, electrical double layer , structure of electrical double layer, origin of electrode potential, Nernst's equation, different types of electrodes, electrochemical cell, galvanic cell, measurement of electromotive force, thermodynamic function of galvanic cell, types of galvanic cell and application of electromotive force .

CHEM 241: *Physical Chemistry (1)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Chemical Thermodynamics [1]: Introduction-Definitions-Energy, work and heat-The first law of thermodynamics-The conversion of Energy-Heat Capacities-Reversible and irreversible change-Reversible isothermal gas expansion-Reversible adiabatic gas expansion-The Joule experiment-The Joule Thomson effect-Thermochemistry-Heats of reaction-Hess Law-Enthalpies of formation-Heat of solution-Kirchhoff's equation-Spontaneous process-The second law of thermodynamics-Heat engines and Carnot's cycle-Efficiency-Entropy-Entropy and spontaneous change-Entropy measures disorder-entropy of mixing-The variation of entropy with concentration-Calculation of entropy changes-Problems.

Part 2: Electrochemistry [1] (reversible electrode processes): Introduction, theories and structure of electric double layer. Electrodes and electrochemical cells. Spontaneous electrode reactions Types of electrochemical cells, galvanic and electrolytic cells. Measuring of the electrode potential and reference electrodes. The electromotive series. Writing the Full-Cell Reactions, Measuring of the emf of a galvanic cell. Nernest equation, concentration and activity. Line Notation of Electrodes and galvanic cells. Classification of electrodes: electrodes of first type, electrodes of second type and electrodes of third type. Classifications of galvanic cells: reversible and irreversible cells, Physical, chemical and concentration cells.

CHEM 242: *Physical Chemistry (3)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Chemical Thermodynamics [2]: The third law of thermodynamics-Absolute entropies-How entropies are measured-Free energy-The Gibbs free energy-The equilibrium temperature-The Helmholtz free energy-The Gibbs-Helmholtz equation-Gibbs free energy and chemical reactions-Variation of Gibbs free energy with pressure-Gibbs free energy and chemical potential-Chemical equilibrium-Measurement of homogeneous gas equilibria-The equilibrium constant and its temperature dependence-Phase equilibrium-Clapeyron equation-Clausius-Clapeyron equation-Problems.

Part 2: Surface Chemistry [1]: Surface tension and surface free energy, contact angle, the equation of Young and Laplace and its experimental verification, Dupre's equation, spreading of a liquid on a substrate, phenomenon at curved interfaces (Kelvin equation), adsorption and

orientation at interfaces, surface activity and Traub`s rule, thermodynamic of adsorption, Gibb`s adsorption equation (dilute solutions), Szyskowski equation (concentrated solution), surfactants: classification, properties, , liquid-liquid interface, , solid-gas and solid-liquid interfaces.

CHEM 243: *Physical Chemistry (2)* **2 Cr.Hr. (L2+P 0)**

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Chemical Kinetics: Introduction; rate of reaction, collision concept for explanation of reaction rate, (a)activation energy (b) active collisions, rate constant. Molecularity & order of reaction, homogeneous & heterogeneous reactions, determination of order of reaction, reversible reactions, side & consecutive reactions, induction period, complex reactions, chain reactions, heterogeneous reactions theories of reaction rate.

Part 2: Phase Equilibria: The phase rule: equilibrium, phases, components, degrees of freedom, derivation of the phase–rule. Systems of one component: Water system, polymorphism, the sulfur system, forms of ice. Two components systems: solutions of gases in liquids, liquid-liquid equilibria (completely miscible liquids, immiscible liquids, partially miscible liquids and the distillation curves). Solid-liquid systems: two components are completely miscible in liquid state and insoluble in solid state, two components are partially miscible in liquid state and insoluble in solid state, two components form a compound with a congruent melting point, two components form a compound with an incongruent melting point, two components form a continuous series of solid solutions, two components are completely miscible in the solid state.

CHEM 244: *Practical Physical Chemistry (I)* **1 Cr.Hr. (L0+P3)**

Prerequisite: CHEM 101 & 102

Practical experiments in chemical thermodynamics, electrochemistry and chemical kinetics

CHEM 245: *Physical Chemistry (A):* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 101 & 102

Part 1: Kinetic Theory of Gases: assumptions, derivations of principle equation, deduction of gas laws, distribution of molecular velocities, derivation of Maxwell's distribution formula of molecular velocities and energies, mean free path, number of collisions. Deviation from ideal behavior, Van der Waal's equation and critical state of a gas, calculation of Van der Waal's, measurements of critical constants, law of corresponding states, liquefaction of gases, cooling methods, effects and applications, principle of equipartition of energy, modes of degrees of freedom, calculation of heat capacities ratio for rigid and elastic mono-, di- and tri-atomic linear and non-linear molecules, Brownian movement, relation with mass particles, Laplace's law, determinations of Avogadro's number by Perrin's method and by other methods.

Part 2: Physical Properties and Molecular Structure: Basic concepts of Physical Properties and Molecular Structure, molar volume, the Parachor, molar refraction, the electrical and magnetic properties, dipole moment, dielectric constant, molar polarization, determination of dipole moment, refractive index, thermochemical quantities, molecular spectra.

CHEM 246: *Bio-physical Chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite: CHEM 102

Organization, Biological macromolecules and the forces that stabilize them. Entropy and dynamics in biomolecules, dynamic light scattering. Thermodynamics of biomolecules (ITC, DSC), Levinthal's paradox: folding conundrum, Quantum mechanics – interaction of electromagnetic radiation with matter. Transition dipole moments. Einstein coefficients, Molecular absorption spectroscopy of peptides and nucleic acids, Linear and circular dichroism, Luminescence spectroscopy (fluorescence, phosphorescence), FRET, FRAP, Time-resolved fluorescence, single-molecule experiments, AFM, Cooperativity and allostery: classic and modern views, Introduction to magnetic resonance, EPR & NMR, Solid-state NMR (SSNMR) spectroscopy, Chemical exchange and biomolecular dynamics Conformational entropy in recognition, rational drug design, Macromolecular structure determination by hybrid approaches.

CHEM 251: *Organic Chemistry* **2Cr.Hr. (L2+P 0)**

Prerequisite: CHEM. 102

Part 1: Aliphatic mono and Polyfunctional Compounds: Types of isomerism , aliphatic alcohols , ethers , mercaptans and thioethers , aldhydes, ketones, mono carboxylic aliphatic acids, amines, dienes compounds and their relation with rubber structure, α , β unsaturated aldhydes and ketones – dialdhydes and diketones Di- and tri carboxylic acids.

Part 2: Aromatic Chemistry: Aromaticity, nitro aromatic compounds , aromatic sulphonic acids , aromatic amines, diazonuim salts, phenol and aromatic alcohols, aromatic aldhydes, ketones, acides and their derivatives.

CHEM 254: *Organic Chemistry* **2Cr.Hr.(L2+P 0)**

Prerequiste: (CHEM 102)

Part 1: Carbohydrates: Introduction, nomenclature - some characteristic reactions. Monosaccharides (determination of the configuration. ring structure, mutarotation, methods for determining the size of the sugar rings. Disaccharides (e.g.sucrose, maltose, lactose, etc) - structure and reactions. Polysaccharides (starch, cellulose, ..etc) structure and reactions. Structure of amylase and amylopectin.

Part 2: Amino acids and proteins: Classification- methods of preparation (Gabriel`s, Strecker, malonic ester, curtius, Darapsky and Erlenmeyer azlactone etc) - analysis of amino acids-reactions. Protein; classification, peptide linkage, the primary structure of peptides. synthesis of peptides, partial hydrolysis of peptides, synthesis of peptides, spatial arrangement of protein molecules.

CHEM 255: *Organic Chemistry* **3Cr.Hr.(L2+P3)**

Prerequisite: (CHEM 102)

Part1: Photochemistry: Energy is quantized, types of excitation, singlet and triplet states. Selection rules, physical process, chemical process. Intramolecular reactions of: 1- olefinic bonds: Geometrical isomerisation, cyclization, rearrangements, 1,5-dienes and the sigmatropic reaction, 2- carbonyl compounds: (Saturated acyclic and side chain, saturated cyclic, α,β- and β,γ-unsaturated, cyclohexadienones. Intermolecular cycloaddition reactions: Photochemical reactions, regioselectivity of photocylcoaddition, the Paterno-Buchi reaction, the dimerization of olefins, cross- coupling of olefins.

Part 2: Chemotherapy: Sulphonamides e.g. (sulphanilamide, sulphapyridine.etc), antimalarials e.g (plasmoquine , mepacrine), arsenical drugs e.g (arsphenamine), antibiotics e.g

penecilline, chloramphenicol, streptomycin, erythromycin. **Practical:** Related to the above topics.

CHEM 260: *Organic chemistry (Aromatic mono & polyfunctional compounds)* 3 Cr.Hr. (L2+P3)

Prerequisite: (CHEM 101 & CHEM 102)

Aromaticity, nitro aromatic compounds , aromatic sulfonic acids , aromatic amines , diazonium salts , phenol and aromatic alcohols , aromatic aldhydes , ketones , acids and their derivatives. Dinitro and diamino aromatic compounds, di- and tri- hydric phenols, phenolic aldhydes and acids, aromatic dicarboxylic acids and their derivatives. Polycyclic hydrocarbons (diphenyl - diarylmethane – arylethane – flurene - naphthalene - anthracene – phenanthracene. This course involves physical and chemical properties – preparation and mechanisms of different reaction. **Practical:** Investigation and identification of organic compounds via chemical reactions and Simple preparation of some organic functional group compounds and their purification.

Chem 261: *Organic chemistry (Aliphatic mono & polyfunctional compounds)* 3 Cr.Hr. (L2+P3)

Prerequisite: (CHEM 101 & CHEM 102)

Types of isomerism , aliphatic alcohols , ethers , mercaptans and thioethers, aldhydes, ketones, mono carboxylic aliphatic acids, amines, diene compounds and their relation with rubber structure. α,β-unsaturated aldhydes and ketones – dialdhydes and diketones Di- and tri carboxylic acids and their derivatives, diethylmalonate, β- ketoesters and their uses for synthesis of mono- and di-acids, mono- and di-ketones.
Practical: Identification of simple organic compounds.

Chem 262: *Organic chemistry* 2 Cr.Hr. (L2+P0)

Prerequisite: (CHEM 101 & CHEM 102)

Part 1 : Petroleum: origin of petroleum - composition of petroleum - refining processes of physical character (distillation, extaction with selective solvent , absorption and adsorption) - refining processes of chemical character(cracking). Some properties of petroleum products and methods of tests. Synthesis of some industrially inportant petrochemicals from simple hydrocarbons. Fraction of simple hydrocarbons.
Part 2: Environmental chemistry: Introduction. Environmental laws and health safety levels. Environmental impact and environmental management. Natural resources global changes and sustainable development. Environmental economics. Environmental biochemistry and chemical toxicology.

CHEM 264: *Organic chemistry (Steroides)* 1 Cr.Hr. (L1+P0)

Prerequisite (CHEM 101 & CHEM 102)

Definition. 1- Sterols - zoosterols (e.g. cholestrol , structure of the ring system , position of the hydroxyl group, and double bond , nature and position of the side chain , position of the two angular methyl groups - spectroscopy.
2- Pyto and myco sterols (e.g. ergoserol, strucuture , ultaviolot irradiation of ergosterol - bile acids - sex hormones) elucidation of structures and biological effect.

Chem 271: *Inorganic Chemistry* 2 Cr.Hr. (L2+P 0)

Prerequisite: (CHEM 101 & CHEM 102)

Part 1: Theories of Bonding: Bonding and structures MO theory for diatomic and polymeric molecules, valance balance bond theory, hybridization and molecular shapes, three-center bond model, ionic solid lattices energy, Born-Haber cycle.

Part 2: Chemistry of Non-Transition Elements: Hydrogen , group I, II, III, IV , V , VI, VII elements and the Nobel gases.

CHEM 272: *Inorganic Chemistry* **2Cr.Hr. (L2+P 0)**

Prerequisite: (-)

Part 1: Inorganic Reaction Mechanisms: The kinetics and reaction mechanisms of inorganic and organo- transition complexes; substitution reactions of octahedral complexes (dissociative, dissociative interchange, associative and associative interchange mechanisms), substitution reactions in square planar complexes and trans effect, oxidation-reduction reactions (inner and outer sphere processes), oxidative addition and reductive elimination reactions, insertion reactions and the application in homogenous catalysis.

Part 2: Bioinorganic Chemistry: Coordination chemistry (theories of complexes, valence bond theory, crystal field theory, magnetism and nomenclature of complexes). Principals of coordination chemistry related to bioinorganic chemistry. Coenzyme B12 (structure and reactivity as radical carrier, mutase activity, role of protein). Hemoglobin and myglobin as oxygen carrier (structure, function of iron, role of protein). Chemotherapy, principles and applications.

Chem 281: *Fundamentals of Analytical Chemistry* **2 Cr.Hr. (L1+P3)**

Prerequisite: (CHEM 101 & CHEM 102)

(Volumetric Analysis, Gravimetric Analysis, and Non-Aqueous Titrations)

Overview of classical methods of quantitative chemical analysis; Methods of expressing concentrations; Errors in chemical analysis and statistical treatment of analytical data; Chemical equilibrium; Chemical calculations; Volumetric titrations including: acid-base; oxidation-reduction, complexometric and precipitation titrations; Non-aqueous titrations and the role of solvents; Leveling effect; differentiating effect and protolysis constant of solvents; Basics of gravimetric and combustion analysis.

Practical: Laboratory tools, glassware and simple instruments; Practice of volumetric analysis: acid-base titrations of single, and binary mixtures and monobasic, dibasic and polybasic species; direct and indirect oxidation-reduction titrations of reducing and oxidizing species; complexometric titrations with EDTA; precipitation titrations with silver nitrate; Non-aqueous titrations; Gravimetric and combustion analysis; applications for the determination of various cations and anions using inorganic and organic reagents.

CHEM 282: *Statistics in analytical Chemistry* **1 Cr.Hr. (L1+P 0)**

Prerequisite: ((CHEM 101 & CHEM 102))

Errors in quantitative analysis and their handlings: precision and accuracy, gross, random and systemic errors; Calculators and computers in statistical calculations; Planning and design of experiments; Statistics of repeated measurements: mean, standard deviation, confidence limits, propagation of errors; Significance tests: t-test, F-test, Chi-Squared test; Calibration methods in instrumental analysis: regression and correlation, limit of detection, limit of quantification;

The method of standard additions; Weighted regression lines; ANOVA and regression calculations; Outliers in regression.

CHEM 290: *Physical Chemistry* **2 Cr.Hr. (L2+P 0)**

Prerequisite: (CHEM 101& CHEM 102)

Part 1: Chemical Thermodynamics [1]: Introduction – Definitions - Energy, work and heat - The first law of thermodynamics - The conversion of Energy - Heat Capacities - Reversible and irreversible change - Reversible isothermal gas expansion -Reversible adiabatic gas expansion - The Joule experiment - The Joule Thomson effect – Thermochemistry -Heats of reaction - Hess Law - Enthalpies of formation - Heat of solution - Kirchhoff's equation - Spontaneous process - The second law of thermodynamics - Heat engines and Carnot's cycle - Efficiency-Entropy - Entropy and spontaneous change - Entropy measures disorder - entropy of mixing - The variation of entropy with concentration - Calculation of entropy changes – Problems.

Part 2: Electrochemistry [1] (reversible electrode processes): Introduction, theories and structure of electric double layer. Electrodes and electrochemical cells. Spontaneous electrode reactions. Types of electrochemical cells, galvanic and electrolytic cells. Measuring of the electrode potential and reference electrodes. The electromotive series. Writing the Full-Cell Reactions, Measuring of the e.m.f. of a galvanic cell. Nernest equation, concentration and activity. Line Notation of Electrodes and galvanic cells. Classification of electrodes: electrodes of first type, electrodes of second type and electrodes of third type. Classifications of galvanic cells: reversible and irreversible cells, Physical, chemical and concentration cells.

CHEM 292: *Physical Chemistry (Chemistry Kinetics)* **2 Cr.Hr. (L1+P 3)**

Prerequisite: (CHEM 101& CHEM 102)

Introduction; rate of reaction, collision concept for explanation of reaction rate, (a)activation energy (b) active collisions, rate constant. Molecularity & order of reaction, homogeneous & heterogeneous reactions, determination of order of reaction, reversible reactions, side & consecutive reactions, induction period, complex reactions, chain reactions, heterogeneous reactions theories of reaction rate.

Practical: Experiments in chemical thermodynamics, physical properties, electrochemistry and chemical kinetics.

CHEM 294: *Physical Chemistry* **2 Cr.Hr. (L2+P0)**

Prerequisite: (CHEM 101& CHEM 102)

Part 1: Kinetic Theory of Gases: assumptions, derivations of principle equation, deduction of gas laws, distribution of molecular velocities, derivation of Maxwell's distribution formula of molecular velocities and energies, mean free path, number of collisions. Deviation from ideal behavior, Van der Waal's equation and critical state of a gas, calculation of Van der Waal's, measurements of critical constants, law of corresponding states, liquefaction of gases, cooling methods, effects and applications, principle of equipartition of energy, modes of degrees of freedom, calculation of heat capacities ratio for rigid and elastic mono-, di- and tri-atomic linear and non-linear molecules, Brownian movement, relation with mass particles, Laplace's law, determinations of Avogadro's number by Perrin's method and by other methods.

Part 2: Physical Properties and Molecular Structure: Basic concepts of Physical Properties and Molecular Structure: molar volume, the Parachor, molar refraction, the electrical and

magnetic properties, dipole moment, dielectric constant, molar polarization, determination of dipole moment, refractive index, thermochemical quantities, molecular spectra.

Course Contents of the Botany Department

BIOL 201: General Biology (for mathematics students) **3 Cr.Hr. (L2+P3)**
Prerequisite (-)
Part II Zoology (L 1 + P 1½ hr)
Part II Botany (L 1 + P 1½ hr)

- Cell structure and function.
- Food as fuel, fermentation, photosynthesis.
- DNA and genetic information.
- RNA and protein synthesis.
- An introduction to diversity of life
- Systematic studies modelling our life: Kingdom prokaryotae – Kingdom Protista (algae) – Kingdom plantae: Bryophytes, Pteridophytes, Spermatophytes (Gymnospermae and Angiospermae)

BOTA 201: Plant Anatomy **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 101)
Introduction, types of stele (protostele + siphonostele) + types of vascular bundles - Secondary body of the plant (cambium): origin, types, activity and factors affecting cambial activity) - Secondary xylem, (vertical and horizontal systems) + wood anatomy, arrangement of xylem vessels, types of wood parenchyma, tylosis & tylosid, sap & heart wood, growth rings - Secondary xylem in dicots and gymnosperms - Secondary phloem in dicots and gymnosperms - The periderm (structure and development), lenticels - Types of stem (vine, woody, herbaceous and conifer) - Secondary growth in dicot and gymnospermic roots - Anamolus secondary growth - Ecological anatomy (hydrophytic and xerophytic stem and leaf).

BOTA 202: Principles of Plant Taxonomy **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 101)
Introduction, meaning of taxonomy, objectives and different types of plant taxonomy - Principles of taxonomy; identification, nomenclature (ICBN) and classification - Units of classification, the history of classification - The basis of engler's classification - General characters of angiosperms (floral characters; the flower structure) - Calyx and corolla (shapes and estivation) - Androecium and gynoecium (adhesion and cohesion of stamens + placentation) - Infloresences (racemose, cymose and special types) - Fruits (simple, compound and aggregate) - Comparison between dicots and monocots characteristics.

BOTA 203: Physiology of Water Relations in Plants **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 102)
Principles of plant physiology including introduction to colloids, imbibition, diffusion, osmosis, permeability and water relations (absorption, translocation and transpiration).

BOTA 204: Archegoniates **3 Cr. hr. (L2 + P2)**
Prerequisite: (BOTA 102)
Introduction - The systematic position of Archegoniates between other living organisms - Basic principles of archegoniate features, Origin, -General characters of Bryophytes: Divisions, Marchantiophyta, Anthocerophyta, and Bryophyta - General characters of Pteridophytes; Divisions: Psilotophyta, Lycopodophyta, Sphenophyta, Filicophyta - General characters of gymnosperms, Divisions: Cycadophyta, Ginkgophyta, Pinophyta, Gnetophyta - discuss morphology, reproduction and life cycle of representative genera for each division- Evolution of Archegoriates.

BOTA 205: Ecosystems **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 102)
Ecosystem and its components - Food chains and food web and their role in the environmental balance, biotic pyramids, biogeochemical cycles (water, carbon, nitrogen, phosphorus), Examples from world major ecosystems (Pond, forest, grassland)

BOTA 206: Phycology **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 102)
Introduction - algal cell structure and reproduction - Different life cycles in algae - Classification of algae – Cyanobacteria – Protochlorophyceae – Chlorophyta – Euglenophyta – Rhodophyta – Phaeophyta – Bacillariophyta – Xanthophyta – Chrysophyta – Dinophyta - Evolution of algae.

BOTA 207: Principles and Tools of Proteomics **1 Cr. hr. (L1 + P0)**
Prerequisite: (BOTA 102)
Introduction to proteomics- Structure and function of proteins- Amino acids as building units of proteins- Proteins synthesis- Protein folding- protein modification- Protein transportation- Cellular function of proteins- Some techniques in proteomic analysis.

BOTA 208: Applied Palynology **2 Cr. hr. (L1 + P2)**
Prerequisite: (BOTA 101)
Introduction (what is palynology) - Compostion and structure of pollen grains and spores; the development of pollen grains wall, apertures, shape of pollen grains and spores, sculpturing - The functional significance of pollen morphology - Numerical approaches to pollen identification - Source of recent and fossil pollen & spore, collection and treatment of samples - Application of palynology; taxonomy, honey studies, climatic change, tracing vegetation history, forensic science, Allergy and petroleum studies.

BOTA 209: DNA Nanotechnology **1 Cr. hr. (L1 + P0)**
Prerequisite: (BOTA 102)
Introduction and terminology of nanotechnology -DNA nanotechnology- Structural DNA assembly – DNA nano pore - DNA arrays- DNA detection, sorting, sequencing - DNA studies by AFM - DNA computer - PCR amplification of DNA fragments -Molecular surgery of DNA - Nanoscale DNA organization - Nanoscale DNA characterization - Studying structural changes of DNA by Quantum size effects – Nano-biosensors - Current and future applications of structural DNA nanotechnology