Academic Programs Booklet

College of Science

2022

Prepared By: VP For Academic Programs and Graduate Studies Office

College of Science

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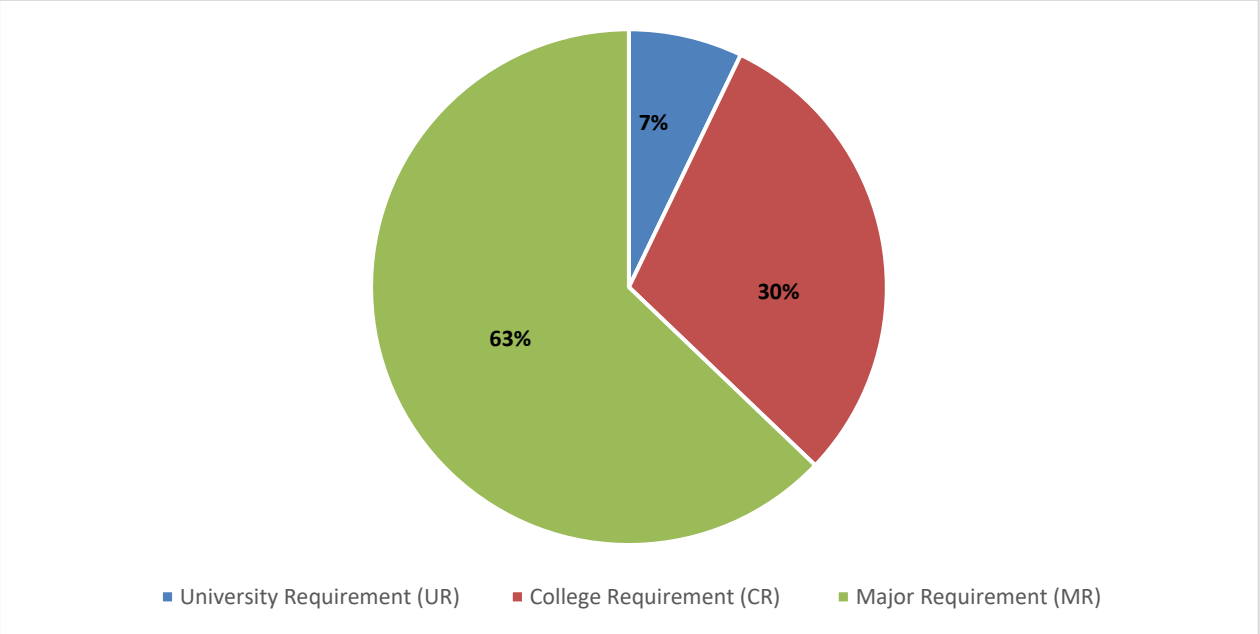
Associate Diploma in Sciences

Program Components



University Requirement (UR)	**5**
College Requirement (CR)	**21/22**
Major Requirement (MR)	**44**
Total Credit (CRD)	**70/71**

Note:

- Study language is English.

Detailed Study Plan (Single Track) 2017

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	-----	No
HRLC 107	Introduction to Human Rights	2	0	2	UR	-----	No
ENGL 125	English for Science I	3	0	3	CR	-----	No
MATHS 121 Or MATH 131	Calculus and Analytic Geometry I Or Calculus I	3 4	0 0	3 4	CR CR	-----	No
PHYCS 101	General Physics I	3	3	4	CR	-----	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ENGL 126	English for Science II	3	0	3	CR	ENGL 125	NO
CHEMY 101	General Chemistry I	3	3	4	CR	-----	No
BIOLS 102	General Biology I	3	3	4	CR	------	No
MATHS 122 Or MATHS 132	Calculus and Analytic Geometry II Or Calculus II	4 4	0 0	4 4	MR* MR*	MATHS 121 MATHS 131	YES YES
PHYCS 102	General Physics I	3	3	4	MR*	PHYCS 101	YES

* Students can select any two courses from the list: MATHS 122/132, PHYSC 102,CHEMY 102 and BIOLS 103.

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
2XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
2XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
2XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES
3/4XX	MATHS / STAT / PHYCS / CHEMY / BIOLS	-	-	3	MR	-----	YES

University Requirements Courses Descriptions

Course Code: HIST 122 **Course Title:** Modern History of Bahrain and Citizenship **Course credits:** (3-0-3)
Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.

Course Code: HRLC 107 **Course Title:** Human Rights Principles **Course credits:** (2-0-2)
This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.

College Requirement Courses Descriptions

Course Code: ENGL 125 **Course Title:** English for Science I **Course credits:** (3-0-3)
This is the first of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing. The course includes an extensive reading programme via a self-access lab.

Course Code: ENGL 126 **Course Title:** English for Science II **Course credits:** (3-0-3)
English for Science is the second of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing.

Course Code: MATHS 121 **Course Title:** Calculus and Analytic Geometry I **Course credits:** (3-0-3)
Limits and continuity. Derivatives and integrals. Applications of derivatives which include mean value theorem, extrema of functions and optimization. Definite integrals and the Fundamental Theorem of Calculus. Derivatives and integrals of exponential, logarithmic and inverse Trigonometric functions.

Course Code: MATHS 131 **Course Title:** Calculus I **Course credits:** (4-0-4)
Limits, Derivatives of Algebraic and Transcendental Functions, Related Rates, the Mean
Value Theorem, Graphing Techniques, Optimization, Integrals and the Fundamental Theorem of Calculus.

Course Code: CHEMY 101 **Course Title:** General Chemistry I **Course credits:** (3-3-4)
Significant figures, chemical formulas and equations; mass relations, limiting reactants and theoretical yield; Physical behaviour of gases; electronic structure, periodic table, covalent bonding; Lewis structures, Molecular structures, hybridization; molecular orbitals, solutions; colligative properties. Related practical work.

Course Code: BIOLS 102 **Course Title:** General Biology I **Course credits:** (3-3-4)
Properties of life; atoms, molecules and chemical bonds; biomolecules; cell structure and function; bioenergetics (intermediary metabolism); cell reproduction; Mendelian genetics; structure of DNA; RNA and protein synthesis; molecular genetics.

Course Code: PHYCS 101 **Course Title:** General Physics I **Course credits:** (3-3-4)
Units and measurements; brief review of vectors; Newton's laws of motion; projectile motion; work and energy; impulse and momentum; rotational dynamics; equilibrium of a rigid body; periodic motion.

Major Requirement Courses Descriptions: Department of Mathematics

Course Code: MATHS 122 **Course Title**: Calculus and Analytic Geometry II (4-0-4)
Methods of integration. Applications to areas; arc length; volumes; etc. Parametric equations. Polar coordinates. Infinite series. Taylors' theorem and power series.

Course Code: MATHS 132 **Course Title**: Calculus II (4-0-4)
Applications of Definite Integrals, L'Hopital's Rule, Integration Techniques, Infinite Series, Taylor and Maclaurin Series, Parametric Equations and Polar Coordinates.

Course Code: MATHS 233 **Course Title:** Calculus III (4-0-4)
Course Description: Vectors. Vector-valued functions. Partial differentiation. Optimization. Multiple integrals, Change of variables, line and surface integrals, Green's and Stokes' theorems.

Course Code: MATHS 205 **Course Title:** Differential Equations (3-0-3)
Differential equations of first order and their solution. Separable and exact equations. Equations convertible to separable type. Higher order linear equations with constant coefficients (homogeneous and nonhomogeneous). Variation of parameters. Laplace transform technique. Applications of differential equations.

Course Code: MATHS 210 **Course Title:** Linear Algebra I (3-0-3)
Matrices and systems of linear equations, determinants, real vector spaces, linear independence, basis and dimension, rank and nullity of matrices.

Course Code: MATHS 254 **Course Title:** Introduction to Abstract Mathematics (3-0-3)
Elementary Logic. Methods of proof. Sets, relations and functions. Cardinality.

Course Code: STAT 271 **Course Title:** Introduction to Probability (3-0-3)
Descriptive Statistics. Sample spaces. Probability functions. Conditional probability. Independence. Combinatorics. Random variables and their distributions. Distribution functions. Geometric, binomial, Poisson and other discrete distributions. Uniform, normal and other continuous distributions. Some limit theorems.

Course Code: STAT 277 **Course Title:** Statistics and Data Science I (2-2-3)
Introduction to R and Python (software installation, libraries, scripts), Computational and Programming Skills, Data Types (static, temporal, spatial), Data Structures (lists, vectors, matrices, frames), Data Science Process (Problem Understanding, Data Acquisition and Processing, Modelling, Deployment).

Course Code: STAT 288 **Course Title:** Data Visualization (2-2-3)
Visualizing Tools and Techniques for Univariate and Multivariate Data, Data Summary and Transformation, Data Dashboards and Interactive Displays, Graphical Modelling and Visual Representation, Results Interpretation and Communication, Model Evaluation.

Course Code: MATHS 301 **Course Title:** Analysis I (3-0-3)
Basic properties of real numbers. Sequences of real numbers. Limits, continuity and differentiation of functions of one real variable.

Course Code: MATHS 302 **Course Title:** Analysis II (3-0-3)
Riemann integral. Series of real numbers. Pointwise and uniform convergence of sequences and series of Functions. Introduction to topology

Course Code: MATHS 331 **Course Title:** Numerical Analysis I (3-0-3)
Floating point computations, solution of equations and systems of equations (linear and nonlinear), interpolation, numerical differentiation and integration. The course emphasizes practice on computer software.

Course Code: MATHS 310 **Course Title:** Linear Algebra II (3-0-3)
Vector spaces and inner product spaces, linear transformations and linear operators, eigenvalues, eigenvectors and diagonalization.

Course Code: MATHS 311 **Course Title:** Abstract Algebra I (3-0-3)
Groups. Homomorphisms. Subgroups. Cyclic Groups. Permutation Groups, Groups of Symmetries. Lagrange's Theorem. Normal Subgroups. Quotient Groups. Direct Products. Isomorphism theorems. Conjugacy. Sylow's Theorems.

Course Code: MATHS 383 **Course Title:** Methods of Applied Mathematics I (3-0-3)
Floating point computations, solution of equations and systems of equations (linear and nonlinear), interpolation, numerical differentiation and integration. The course emphasizes practice on computer software.

Course Code: MATHS 343 **Course Title:** Complex Analysis (3-0-3)
Course Description: Complex numbers. Analytic functions. Power series. Cauchy integral theorem and formula. Residues. Contour integration.

Course Code: MATHS 371 **Course Title:** Theory of Interest (3-0-3)
Introduction to the mathematics of interest and the evaluation of interest related products including annuities with Non-contingent payments, loans, bonds, general cash flows, portfolios, and immunization. Sources of interest rates, stochastic interest rates, and financial instruments such as shorts, swaps, and options. General derivatives, forwards and futures, hedging and investment strategies.

Course Code: MATHS 372 **Course Title:** Financial Economics for Actuaries (3-0-3)
Forward, futures, swaps, and other derivatives. Option pricing theory. Interest rate modeling and simulation. Brownian motion. Black-Scholes formula. Delta-Hedging. Exotic Options. Risk Management techniques.

Course Code: MATHS 483 **Course Title:** Methods of Applied Mathematics II (3-0-3)
Green's functions, Fourier transforms, Fourier analysis techniques for PDEs, Linear integral equations.

Course Code: MATHS 471 **Course Title:** Life Contingencies I (3-0-3)
This course introduces students to the mathematical theory of contingencies. Topics include survival distributions, individual risk models, life tables, topics from life insurance, life annuities and benefit premiums.

Course Code: MATHS 472 **Course Title:** Life Contingencies II (3-0-3)
This course is a continuation of the study of life contingencies. Topics include benefit reserve, multiple life functions, multiple decrement models, random and deterministic survivorship group, valuation of pension plans, and applications.

Course Code: MATHS 473 **Course Title:** Loss Models I (3-0-3)
This course introduces students to the construction and evaluation of actuarial models. Topics include measures of risk, characteristics of actuarial models, severity models, frequency models and aggregate loss models.

Course Code: MATHS 474 **Course Title:** Loss Models II (3-0-3)
This course is a continuation of the study of actuarial models. Topics include estimation of data, parameter estimation, model selection, simulation and credibility.

Course Code: STAT 371 **Course Title:** Probability and Statistics I (3-0-3)
Random variables and probability distributions. Moment generating Functions. Joint Probability distributions. Normal, gamma, Chi square and other distributions. Central Limit Theorem.

Course Code: STAT 372 **Course Title:** Probability and Statistics II (3-0-3)
Point and interval estimation. Sampling distributions. t-, Chi-square and F-distributions. Test of hypotheses. Likelihood ratio test. Neyman-Pearson lemma. Correlation and regression.

Course Code: STAT 374 **Course Title:** Regression Analysis (3-0-3)
Simple linear regression. Multiple linear regression. Analysis of residuals. Multicollinarity. Biased estimation. Sensitivity analysis. Selection of Variables. Non-linear regression. Response surface and correlation analysis.

Course Code: STAT 377 **Course Title:** Statistics and Data Science II (2-2-3)
Statistical Inference, Parameter Estimation, Hypothesis Testing, Confidence Intervals, Simulation and Resampling, Continuous and Categorical Data, Linear and Nonlinear Regressions, Logistic Regression.

Course Code: STAT 381 **Course Title:** Time Series Analysis (3-0-3)
Introduction to linear and stationary time series. Autocorrelation modeling. Autoregression modeling. Moving average. ARMA models. ARIMA models. Introduction to spectral analysis of a time series. Introduction to non-linear time series.

Course Code: STAT 384 **Course Title:** Bayesian Inference (3-0-3)
Bayes Theorem. Prior and posterior distributions. Loss and risk functions. Baye's risk. Bayesian estimation of parameters of Binomial, Poisson, geometric, gamma, beta and normal distributions. Bayesian intervals. Bayesian procedures for testing hypothesis. Bayesian analysis of linear models.

Course Code: STAT 473 **Course Title:** Introduction to Multivariate Analysis (3-0-3)
Aspects of multivariate analysis. Matrix algebra and random vectors. Sample geometry and random sampling. The multivariate normal distribution. Inference about a mean vector. Comparisons of several multivariate means. Principal components. Factor analysis and inference for structured covariance matrices. Discrimination and classification. Clustering.

Course Code: STAT 480 **Course Title:** Advanced Statistical Models (2-2-3)
Exponential Family, Generalized Linear Models, Generalized Additive Models, Nonparametric Regression (kernel, spline, local polynomials).

Course Code: STAT 481 **Course Title:** Fundamentals of Data Mining (2-2-3)
Concepts and Techniques of Data Mining, Knowledge Discovery, Pattern Recognition, Outlier Detection, Algorithms for Association Rule Mining, Regression, Classification, Clustering.

Course Code: STAT 482 **Course Title:** Fundamentals of Machine Learning (2-2-3)
Machine Learning Algorithms: Supervised Learning and Unsupervised Learning, Regressions Methods, K-Nearest-Neighbor, Naïve Bayes, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Support Vector Machine, Decision Tress, K Means Clustering, Hierarchical Clustering. Model Building, Training, Validation, and Testing.

Course Code: STAT 483 **Course Title:** Introduction to Big Data Technologies (2-2-3)
Data Science Process (data collection, managing, storing, sharing, cleansing, exploring, analyzing data, interpreting and communicating results), Big Data Tools including Hadoop, Map-Reduce, Spark.

Major Requirement Courses Descriptions: Department of Physics

Course Code: PHYCS 102 **Course Title:** General Physics II (3-3-4)
Electric charges and fields; Coulomb's and Gauss's laws; electric potential; capacitors and dielectrics; direct current circuits; Kirchoff's rules; magnetic field and flux; ampere's law; induced emf; Lenz's law; mutual and self inductance; AC circuits; RLC circuit.

Course Code: PHYCS 209 **Course Title:** Bulk Properties of Matter (3-2-3)
Elasticity; fluid statics and dynamics; mechanical waves; vibrating bodies; acoustic phenomena; kinetic theory of gases; first and second law of thermodynamics; geometrical optics.

Course Code: PHYCS 221 **Course Title:** Methods of Mathematical Physics I (3-0-3)
Curvilinear coordinates; vector calculus; multiple integrals; ordinary differential equations; power series; complex numbers; linear equations; matrices and determinants; Fourier series; application to physics problems.

Course Code: PHYCS 222 **Course Title:** Modern Physics (3-2-3)
The special theory of relativity; relativistic dynamics; blackbody radiation; the photoelectric effect; Compton effect; pair production and annihilation; bremsstrahlung and x-ray production; wave-particle duality; de Broglie's hypothesis; the uncertainty relationships; the Schrodinger equations and applications; elementary particles.

Course Code: PHYCS 241 **Course Title:** Introductory Electronics (3-2-3)
Properties of semiconductors; diode characterization; Zener diodes; tunnel diodes; photodiodes; construction and operation of bipolar junction and field effect transistors; dc biasing; stabilization; small signal analysis of BJT; JFET and MOSFET amplifiers; multistage systems; operational amplifiers.

Course Code: PHYCS 314 **Course Title:** Classical Mechanics (3-2-3)
Dynamics of particles; conservation theorem and symmetries; linear harmonic oscillations; Lagrangian and Hamiltonian dynamics; motion of particles and systems in a central force field; dynamics of a system of particles (collision and scattering).

Course Code: PHYCS 324 **Course Title:** Atomic and Molecular Physics (3-2-3)
Atomic model; the Rutherford nuclear atom; the Bohr model; line spectra; the Schrodinger equation in spherical coordinates; quantum numbers and degeneracy; the hydrogen atom wave functions; intrinsic spin and spin angular momentum; the Pauli exclusion principle; addition of angular momenta; the hydrogen molecule; molecular vibrations and rotations; molecular spectra.

Course Code: PHYCS 326 **Course Title:** Quantum Mechanics I (3-2-3)
Postulates of quantum mechanics; operators; eigenfunctions and eigenvalues; Dirac formalism in Hilbert space; time variation of expectation values and conservation laws; Hamiltonian operator; harmonic oscillator; angular momentum algebra; eigenvalues and eigenfunctions of the Schrodinger equation for central forces with hydrogen-atom as an example; time independent perturbation theory.

Course Code: PHYCS 331 **Course Title:** Physical Optics (3-2-3)
Periodic motion; superposition of periodic motions; free vibrations of physical systems; properties of light; interference of light; Fraunhofer diffraction; the double slit experiment; diffraction; the double slit experiment; the diffraction grating; Fresnel diffraction; absorption and scattering; dispersion; reflection and polarization of light.

Course Code: PHYCS 348 **Course Title:** Electromagnetic Theory (3-2-3)
Vector calculus; electrostatic fields; electric fields in dielectric materials; solutions for the electrostatic boundary-value problems; the magnetic field; magnetic materials; electromagnetic induction and the flow of power; Maxwell's equations; plane electromagnetic waves; Poynting vector.

Course Code: PHYCS 351 **Course Title**: Solid State Physics I (3-2-3)
Structure of crystals; diffraction of x-rays; thermal properties of solids; free electron theory of metals; the band theory of solids; Maxwell-Boltzmann and Fermi-Dirac distributions; phonons and lattice vibrations; atomic bonding; non-crystalline solids; introduction to semiconductors.

Course Code: PHYCS 365 **Course Title:** Thermal Physics (3-2-3)
Fundamental concepts in thermodynamical systems; equations of state; the first law of thermodynamics; consequences of the first law; entropy and the second law of thermodynamics; combined first and second laws; thermodynamic potentials; the principle of equation of energy; equation of state of an ideal gas; classical theory of specific heat; statistical thermodynamics and applications.

Course Code: PHYCS 425 **Course Title:** Computational Physics (3-2-3)
Finite difference solution of differential equations, Newton's equation of motion in one and two dimensions, two body problem, simple linear and nonlinear systems, chaotic motion of dynamical systems, random processes, dynamics of many particle systems.

Course Code: PHYCS 432 **Course Title**: Laser Physics (3-2-3)
The nature of light; polarization and coherence of light; detection of electromagnetic radiation; laser construction and operation; characteristics of laser light; laser pumping rate; oscillations; gain and threshold; optical resonators; multimode laser operation; specific lasers and pumping mechanisms; laser applications.

Course Code: PHYCS 471 **Course Title**: Nuclear Physics (3-2-3)
Nuclear properties; angular momentum and parity; nuclear models; nuclear decay and radioactivity; detection of nuclear radiation; nuclear reactions; nuclear fission; nuclear fusion; accelerators; introduction to nuclear structures.

Major Requirement Courses Descriptions: Department of Chemistry

Course Code: CHEMY 102 **Course Title:** General Chemistry II (3-3-4)
Gaseous equilibrium (equilibrium constant, Kc and Kp); acids and bases (water dissociation, pH, weak acids and bases, salts); acid-base and precipitation equilibria (buffers, indicators, titrations, pH curves);thermochemistry (calorimetry, enthalpy, thermochemical equations, heats of formation, first law of thermodynamics); rate of reaction, rate and concentration, concentration and time, activation energy, rate and temperature, catalysis, mechanisms; electrochemistry; voltaic cells; cell voltages. Organic Chemistry (alkanes, alkenes, alkynes, isomerism, nomenclature, arenes, functional groups, reaction). Related practical work.

Course Code: CHEMY 211 **Course Title:** Analytical Chemistry I (3-2-3)
Evaluation of analytical data; gravimetric and volumetric methods of analysis; precipitation titrimetery; complex formation titration; analytical electrochemistry and introduction to spectroscopy.

Course Code: CHEMY 221 **Course Title:** Organic Chemistry I (3-2-3)
Fundamental concepts and technique in organic chemistry: The nature of organic compounds, alkanes and cycloalkanes; stereo chemistry of alkanes and overview of organic reactions; alkenes; structure and reactivity; alkenes; reactions and synthesis; alkynes; stereochemistry; alkyl halides and reactions of alkyl halides; nucleophilic substitution and elimination reactions. Related practical work.

Course Code:CHEMY 231 **Course Title:** Physical Chemistry I (3-2-3)
Concepts and techniques in physical and theoretical chemistry including thermochemistry; the laws of thermodynamics; properties of gases; solution chemistry and colligative properties; phase equilibria; electrolytes and ionic equilibria; free energy and equilibrium.

Course Code: CHEMY 241 **Course Title:** Inorganic Chemistry I (3-2-3)
A comparative and systematic study of the physical and chemical properties of representative metals and non- metals: Occurrence, abundances, extraction, uses, periodic trends, solubility, hydrolysis; common compounds of metals and non-metals; valence octet limitation and inert-pair effect; multicenter bond; catenation in chemistry of non-metals. Molecular structure and bonding: energytic of covalent and ionic bond formation. Structure of simple solids: energytic of ionic bond formation and Born-Haber cycle. Acids and bases: characteristics, reactions, and properties (HSAB). Oxidation and reduction: variation of oxidation states. Inorganic thermodynamics. Related practical work.

Course Code: CHEMY 311 **Course Title:** Analytical Chemistry II (3-0-3)
Methods of Analysis, Spectroscopic methods of analysis; properties of electromagnetic radiation; absorption spectroscopy; fluorescence and phosphorescence; optical spectroscopic instruments; applications of absorption spectroscopy to qualitative and quantitative analysis; atomic spectrometric methods; analytical separation and chromatography.

Course Code: CHEMY 312 **Course Title:** Practical Analytical Chemistry (0-6-3)
Fundamental basis of instrumental analysis; detection limits; sampling methods; processing of experimental data; applications of chromatographic; electrochemical, spectral and thermal methods in quantitative and qualitative chemical analyses.

Course Code: BIOLS 315 **Course Title: Biochemistry** (2-3-3)
Principles of biological chemistry; the chemistry of water, acids and bases, and buffer control of pH. Protein structure and function; principles of enzymology, and carbohydrate, lipid, and nucleic acid structure and function. Basic intermediate metabolism including: protein, carbohydrate and lipid synthesis and breakdown; Kreb's cycle and oxidative phosphorylation; pentose phosphate pathway and the process of photosynthesis.

Course Code: CHEMY 321 **Course Title:** Organic Chemistry II (3-0-3)
Conjugated dienes; benzene and aromaticity; electrophilic aromatic substitution reactions; alcohols, phenols and thiols; ethers, expoxides and sulfides, aldehydes and ketones; carboxylic acids and carboxylic acid derivatives aliphatic, aromatic derivatives, aliphatic and aromatic amines.

Course Code: CHEMY 322 **Course Title:** Practical Organic Chemistry (0-6-3)
Advanced preparations of some multistep synthesis using important synthetic reagents and reactions of the following types: substitution, elimination, addition, rearrangement, cyclization, oxidation, reduction and alkylation.

Course Code: CHEMY 323 **Course Title:** Organic Spectroscopy (3-0-3)
Electromagnetic radiation; infrared and ultraviolet-visible spectrum; interpretation of IR and UV spectra; nuclear magnetic resonance; chemical shift; counting of protons; spin-spin coupling; splitting patterns; spin-spin splitting; 1H-NMR and 13C-NMR; basic principles of mass spectroscopy; the use of molecular spectroscopy for the identification and elucidation of organic structures.

Course Code: CHEMY 331 **Course Title:** Physical Chemistry II (3-0-3)
Solution of electrolytes; transport numbers; thermodynamics of ion; ionic equilibrium; the Donan equilibrium; electrochemical cells; thermodynamics of electro - chemical cells; reaction kinetics; reactions in solutions; composite reaction mechanism; chain reaction; catalysis; photochemical reactions; surface chemistry and colloids.

Course Code: CHEMY 332 **Course Title:** Practical Physical Chemistry (3-0-3)
Techniques in physical measurement and quantitative studies, illustrated through experiments on thermodynamics, electrochemistry, transport phenomena, reaction kinetics, surface chemistry and colloids.

Course Code: CHEMY 341 **Course Title:** Inorganic Chemistry II (3-0-3)
Broad based topics in coordination chemistry. The development of coordination chemistry; Werener's theory; types of Lewis acid and base ligands and hard and soft acids and bases; preparation and stability of complex compounds; bonding; valence bond treatments; crystal field; ligand field and molecular orbital theories; electronic spectra, magnetic properties; stereochemistry of coordination compounds, mechanism of complex-ion reactions.

Course Code: CHEMY 342 **Course Title:** Practical Inorganic Chemistry (0-6-3)
Investigation of chemical problems through a wide variety of techniques including preparation, separation, and instrumental, gravimetric and volumetric analysis of transition coordination compounds.

Course Code: CHEMY 411 **Course Title:** Analytical Chemistry III (3-0-3)
Electro analytical methods (polarography, voltammetry, coulometry); solvent extraction distribution coefficient, per cent of extraction, solvent extraction of metals; separation methods including the theory and application of gas- liquid chromatography, high performance liquid chromatography and electrophoresis; mass spectrometry (principles, instrumentation and applications); X-ray spectrometry (absorption, fluorescence and diffraction methods); nuclear magnetic resonance.

Course Code: CHEMY 421 **Course Title:** Organic Chemistry III (3-0-3)
Carbonyl Alpha - Substitution reactions, carbonyl condensation reactions; heterocycles and nucleic acids; orbitals and organic chemistry; pericyclic reactions; carbohydrates; lipids; amino acids, peptides and proteins.
Reversible systems, Electro analytical Methods, Electrode Kinetics, Electrolysis, Industrial applications.

Course Code: CHEMY 432 **Course Title:** Chemical Dynamics: Catalysis and Surface Chemistry (3-0-3)
Quantum mechanics: principles, techniques and applications; atomic structure and atomic spectra; molecular structure; molecular symmetry; molecular spectroscopy: rotational, vibrational and electronic spectra, magnetic spectroscopy; statistical mechanics.

Course Code: CHEMY 441 **Course Title:** Application of Group Theory to Inorganic Chemistry (3-0-3)
A semi-mathematical approach to group theory is developed through the stages of recognition of symmetry elements and operations, evaluation of binary products; properties of groups and group elements; systematic determination of point-group symmetries; generation of reducible and irreducible representations; and the construction and uses of point group character tables. Group theoretical treatment is applied to the symmetry of atomic orbitals; fundamental vibration stretching frequencies; hybridization schemes for atomic orbitals; crystal field splitting patterns, symmetry allowed electronic transitions, and molecular orbitals in transition metal complexes.

Major Requirement Courses Descriptions: Department of Biology

Course Code: BIOLS 103 **Course Title:** General Biology II (3-3-4)
Course Description: Classification of organisms; plant structure and function; animal structure and function; evolutionary theory; ecology and modern biological problems.

Course Code: BIOLS 222 **Course Title:** Plant Morphology (2-3-3)
The organography, anatomy and methods of reproduction of the major divisions and classes of algae, fungi, liverworts, mosses, ferns, gymnosperms and angiosperms; the study of the monocotyledonous and dicotyledonous families.

Course Code: BIOLS 232 **Course Title:** Invertebrate Zoology I (2-3-3)
Course Description: Classification, biology, diversity, structural features and phylogeny of major lower and higher taxonomic groups of invertebrates.

Course Code: BIOLS 234 **Course Title:** Chordate Zoology (2-3-3)
Course Description: Classification and biology of chordates: protochordates, hemichordates, urochordates, cephalochordates and vertebrates.

Course Code: BIOLS 250 **Course Title:** Microbiology (2-3-3)
Microbial world and its development; scope of microbiology; microbial taxonomy and nomenclature; morphology and fine structure; microbial growth and metabolism; control of microorganisms; microorganisms and diseases; exploitation of microorganisms by man.

Course Code: BIOLS 300 **Course Title**: Cell Biology (2-3-3)
Structural and chemical basis of cell functions, including energy and matter conversion; transport across cell membranes, excitability, contractility, internal membrane of cytoskeleton.

Course Code: BIOLS 315 **Course Title:** Biochemistry (2-3-3)
Principles of biological chemistry; the chemistry of water, acids and bases, and buffer control of pH. Protein structure and function; principles of enzymology, and carbohydrate, lipid, and nucleic acid structure and function. Basic intermediate metabolism including: protein, carbohydrate and lipid synthesis and breakdown; Kreb's cycle and oxidative phosphorylation; pentose phosphate pathway and the process of photosynthesis.

Course Code: BIOLS 320 **Course Title:** Plant Physiology (2-3-3)
Course Description: Water relations; uptake and accumulation of solutes; mineral nutrition; photosynthesis; respiration; nitrogen metabolism; growth and growth hormones; environmental stress.

Course Code: BIOLS 340 **Course Title:** General Ecology (2-3-3)
Concept of ecosystems, including the physical and biological environments; communities; succession; climax communities; energy cycles; food webs; mineral cycles; water cycles; the inter-relationships between living organisms and their physical environment.

Course Code: BIOLS 360 **Course Title:** Principles of Genetics (2-3-3)
DNA and RNA; replication; translation and its code; regulation of gene expression; Mendelian vs. non-mendelian inheritance; mapping the eucaryotic chromosome; sex determination and differentiation; genes and environment; mutation and mutagenesis; immunogenetics; an introduction to population genetics.

Course Code: BIOLS 372 **Course Title:** Human Physiology (2-3-3)
Anatomy and physiology of Man with special emphasis on the integumentary, skeletal, muscular, digestive, respiratory, excretory, reproductive, circulatory, endocrine and nervous systems. In each case the contribution of the system to general homeostasis will be discussed.

Course Code: BIOLS 380 **Course Title:** Marine Biology (2-3-3)
Basic principles of marine biology; evolution of the sea basins; marine biota's and their ecology; seawater chemistry and marine pollution. Field and laboratory work is an integral part of the course.

Course Code: BIOLS 404 **Course Title:** Biotechnology (2-3-3)
Basic principles of biotechnology; microbial screening and strain improvement; biological regulation; transport phenomena and bioreactor design. Microbial biomass and protein source, anaerobic digestion, industrial alcohol production and purification of fine enzymes. Production of antibiotics; genetic engineering and its applications; plant and animal cell culture techniques.

Course Code: BIOLS 451 **Course Title**: Immunology (2-3-3)
Production and function of immunoglobulin, characteristics of immunogens; prevention of infectious disease; hypersensitivity and allergy; cell-mediated immunity; transplantation and autoimmune diseases.

Course Code: BIOLS 465 **Course Title:** Gene Technology (2-3-3)
Perpetuation of DNA; fine structure of the gene; mapping bacterial and viral chromosomes; transposition. Gene cloning: isolation and characterization of DNA and the gene, development of cloning vectors, in vitro mutagenesis; introduction of different vectors to prokaryotes and eucaryotes.