BSc (Hons) Chemistry – SC310
(Under Review)

1. Mission, Aims and Objectives

Chemistry is considered as the "central" science because it involves all of the other sciences. Chemistry seeks to understand the nature of matter in terms of atoms and molecules and the changes it undergoes.

The mission of the Department of Chemistry is to provide students with the appropriate level of modern and comprehensive chemical education required for life and work in our technologically advanced society. The Department offers a three year full time BSc(Hons) chemistry programme, suitable for a wide range of career goals, both industrial and academic.

The modules offered at undergraduate level emphasise the fundamental principles of chemistry while developing experimental skills. The aims are to train students develop their critical thinking and problem-solving skills to enable them tackle problems in the real world using their chemical knowledge. In an attempt to bring more applied knowledge to this programme, the Department of Chemistry offers a number of electives in polymer chemistry, environmental chemistry, computational chemistry, industrial chemistry, quality control and forensic science.

The Department encourages a variety of research interests in a broad spectrum of the chemical field addressing both pure and applied chemistry aiming at advancing the frontiers of knowledge and solving issues of national importance. It offers MPhil/PhD programmes in these areas and also encourages student involvement in research projects.

The Department also endeavours to promote capacity building in the chemical field and to provide consultancy services as well as to act as an advisory organ to public and private sectors.

2. General Entry Requirements for Admission to the University

As per General Entry Requirements for admission to the University for undergraduate degrees.

3. Programme Requirements

Credit at GCE ‘O’ level including Mathematics.
Pass at GCE 'A' Level in Chemistry.

4. Programme Duration

	Normal	**Maximum**
BSc (Hons) Chemistry	6 Semesters	10 Semesters

5. Credit System

15 Hours Lectures and/or Tutorials - 1 Credit.
15 Hours of Practical Work – 0.5 Credit.

6. Credits per Year

Minimum 18 credits; Maximum (including retake modules): 48 credits.

7. Minimum Credits Required for Award

BSc (Hons) Chemistry: 105

Breakdown as follows:

	Credits from			
Degree	**Core Taught Modules**	**Project**	**Electives[a]**	**GEMs[bc]**
BSc (Hons) Chemistry	75	9	15-21	0-6

[a]For BSc (Hons) Chemistry: at least 15 credits from electives offered by the Chemistry Department with at least 6 credits (two electives) from year 2 and at least 6 credits (two electives) from year 3.

[b]GEMs: to be taken normally within years 1 & 2.

8. Assessment

Each module will carry 100 marks (i.e. expressed as %) and will be assessed as follows (unless otherwise specified):

Assessment will be based on a written examination of 3-hour duration for 5/6 credit modules and 2-h for 3 credit modules and on continuous assessment carrying 30% of total marks, except for a programme where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory work, and/or assignments and should include at least 1 class test for 3 credit modules and 2 class tests for 5/6 credit modules.

An overall total of 40% for combined continuous assessment and written examination components would be required to pass a module, without minimum thresholds within the individual continuous assessment and written examination.

CHEM 1051Y(1) and CHEM 2051Y(3) will be assessed solely by continuous assessment.

Modules will carry the weightings of 1, 3 or 5 depending on their status (Introductory, Intermediate or Advanced). Weighting for a particular module is indicated within parentheses in the module code.

9. Important Note

The rules as stipulated in this Programme Structure and Outline Syllabus will replace all other rules and regulations.

10. List of Modules

A. CHEMISTRY CORE MODULES (84 credits)

Code	Module Name	Hrs L+P	Credits
CHEM 1011Y(1)	Organic Chemistry I	75+0	5
CHEM 1021Y(1)	Physical Chemistry I	75+0	5
CHEM 1031Y(1)	Inorganic Chemistry I	75+0	5
CHEM 1041Y(1)	Analytical & Environmental Chemistry I	75+0	5
CHEM 1051Y(1)	Practical Chemistry I	0+150	5
CHEM 1061Y(1)	Maths for Chemists	45+0	3
CSE 1010e(1)	Introduction to IT	O.E.	3
CHEM 2011Y(3)	Organic Chemistry II	90+0	6
CHEM 2021Y(3)	Physical Chemistry II and Polymer Chemistry I	90+0	6
CHEM 2031Y(3)	Inorganic Chemistry II	90+0	6
CHEM 2041Y(3)	Analytical Chemistry II	45+0	3
CHEM 2051Y(3)	Practical Chemistry II	0+150	5
CHEM 3000(5)	Project	-	9
CHEM 3011Y(5)	Organic Chemistry III	90+0	6
CHEM 3021Y(5)	Physical Chemistry III	90+0	6
CHEM 3031Y(5)	Inorganic Chemistry III	90+0	6

B. DEPARTMENTAL ELECTIVES (Not all modules may be on offer)

CHEM 2064Y(3)	Topics in Biochemistry	37.5+15	3
CHEM 2065Y(3)	Industrial Chemistry	37.5+15	3
CHEM 2066Y(3)	Computational Chemistry	37.5+15	3
CHEM 2067Y(3)	Environmental Chemistry II	30+30	3
CHEM 2070Y(3)	Forensic Chemistry I	37.5+15	3
CHEM 3064Y(5)	Polymer Chemistry II	40+10	3
CHEM 3065Y(5)	Selected Topics in Environmental and Analytical Chemistry	40+10	3
CHEM 3066Y(5)	Quality Control and Quality Management	40+10	3
CHEM 3067Y(5)	Supramolecular Chemistry	45+0	3
CHEM 3070Y(5)	Forensic Chemistry II	40+10	3

and modules offered by any other units/departments.

The Department reserves the right to offer additional electives.

Note: For the award of BSc (Hons) Chemistry, students are required to choose at least 15 credits offered by the Chemistry Department with at leasttwo electives offered in Year 2 and at least two electives offered in Year 3.

11. Programme Plan – BSc (Hons) Chemistry

YEAR 1

Code	Module Name	Hrs L+P	Credits
CORE			
CHEM 1011Y(1)	Organic Chemistry I	75+0	5
CHEM 1021Y(1)	Physical Chemistry I	75+0	5
CHEM 1031Y(1)	Inorganic Chemistry I	75+0	5
CHEM 1041Y(1)	Analytical & Environmental Chemistry I	75+0	5
CHEM 1051Y(1)	Practical Chemistry I	0+150	5
CHEM 1061Y(1)	Maths for Chemists	45+0	3
CSE 1010e(1)	Introduction to Information Technology	O.E.	3

and/or modules to be chosen from any other units/departments or any new modules offered by the Department.

YEAR 2

Code	Module Name	Hrs L+P	Credits
CORE			
CHEM 2011Y(3)	Organic Chemistry II	90+0	6
CHEM 2021Y(3)	Physical Chemistry II and Polymer Chemistry I	90+0	6
CHEM 2031Y(3)	Inorganic Chemistry II	90+0	6
CHEM 2041Y(3)	Analytical Chemistry II	45+0	3
CHEM 2051Y(3)	Practical Chemistry II	0+150	5
ELECTIVES			
CHEM 2064Y(3)	Topics in Biochemistry	37.5+15	3
CHEM 2065Y(3)	Industrial Chemistry	37.5+15	3
CHEM 2066Y(3)	Computational Chemistry	37.5+15	3
CHEM 2067Y(3)	Environmental Chemistry II	30+30	3
CHEM2070Y(3)	Forensic Chemistry 1	37.5+15	3

and/or modules to be chosen from any other units/departments or any new modules offered by the Department.

YEAR 3

Code	Module Name	Hrs L+P	Credits
CORE			
CHEM 3000Y(5)	Project	-	9
CHEM 3011Y(5)	Organic Chemistry III	90+0	6
CHEM 3021Y(5)	Physical Chemistry III	90+0	6
CHEM 3031Y(5)	Inorganic Chemistry III	90+0	6
ELECTIVES			
CHEM 3064Y(5)	Polymer Chemistry II	40+10	3
CHEM 3065Y(5)	Selected Topics in Environmental and Analytical Chemistry	40+10	3
CHEM 3066Y(5)	Quality Control and Quality Management	40+10	3
CHEM 3067Y(5)	Supramolecular Chemistry	45+0	3
CHEM 3070Y(5)	Forensic Chemistry II	40+10	3

and/or modules to be chosen from any other units/departments or any new modules offered by the Department.

NOTE: NOT ALL ELECTIVES MAY BE ON OFFER

12. Outline Syllabus

CHEM 1011Y(1) - ORGANIC CHEMISTRY I
Structure and bonding (molecular orbitals, hybridisation, dipoles, resonance), nomenclature of organic compounds, reaction mechanisms using curly arrows, stereochemistry of open chain organic compounds, chemistry of main functional groups (aliphatic and aromatic) with emphasis on synthesis and reactivity, reactions of naphthalene and its derivatives, an introduction to spectroscopic techniques in organic chemistry (UV-Visible, IR).

CHEM 1021Y(1) - PHYSICAL CHEMISTRY I
Chemical Thermodynamics I: kinetic theory of gases, 1^{st}, 2^{nd}& 3^{rd} laws of thermodynamics, thermochemistry, ionic equilibria, acid-base reactions, gravimetry, redox reactions, solubility product.
Quantum Chemistry I: wave-particle behaviour of the electron, Bohr's theory of the H-atom, Schrödinger's equation and application to simple systems (1-D box), symmetry, symmetry elements and operations, classification into groups, kinetics, reaction orders, rate laws, elementary reactions, steady state approximation, reaction mechanisms.

CHEM 1031Y(1) - INORGANIC CHEMISTRY I
Acids and bases, non-aqueous solvents, oxidation-reduction, basic solid state chemistry, shapes of molecules, molecular orbital theory, chemistry of main group elements.

CHEM 1041Y(1) - ANALYTICAL & ENVIRONMENTAL CHEMISTRY I
Analytical process, precision glassware, calibration methods, fundamentals of spectrophotometry, application of spectrophotometry, spectrophotometers, atomic spectroscopy (absorption; emission; fluorescence), introduction to analytical separations, gas chromatography.
Biogeochemistry of major elements (carbon, nitrogen, phosphorus), sediment chemistry, ecotoxicity (Pb, Cr, Cu, Zn, Cd), hydrogeochemistry, coastal and aquatic pollution, contamination, conservation, environmental and risk management, environmental assessment, air pollution and chemical cycles.

CHEM 1051Y(1) - PRACTICAL CHEMISTRY I
Practicalsof 150 hours total duration drawn equally from modules CHEM 1011Y(1), CHEM 1021Y(1), CHEM 1031Y(1) and CHEM 1041Y(1)covering topics in inorganic, organic, physical and analytical/environmental chemistry and core.

CHEM 1061Y(1) - MATHS FOR CHEMISTS
Factorising, solving quadratic equations, solving linear systems of equation, partial fractions, inequalities, sigma and pi notation, functions, trigonometric, exponential, logarithmic, inverse functions, essential co-ordinate geometry, complex numbers, series, differentiation, differentiation of basic functions, product rule, quotient rule, minima and maxima, chain rule, curve sketching and essential coordinate geometry, complex numbers, Maclaurin and Taylor series, integration, integration of basic functions, integration by substitution, integration by parts, finite integration, numerical integration, functions of several variables and partial differentiation, differential equations, first and second order differential equations, boundary conditions, matrix notation,elementary matrix operations, properties, determinants, invertible matrices, Eigenvalues and eigenvectors, probability and statistics, permutations and combinations, introduction to statistics, regression analysis, plotting of curves, data analysis.

CHEM 2011Y(3) - ORGANIC CHEMISTRY II PQ: CHEM 1011Y(1)
Chemistry of the carbonyl group, Diels-Alder reactions, basic heterocyclic chemistry (synthesis and reactivity of pyridine, pyrrole, furan and thiophene), oxidation and reduction methods in synthesis, spectroscopy (^{1}H NMR, ^{13}C NMR and mass spectrometry) and structure elucidation, stereochemistry and stereochemical aspects of reactivity of selected alicyclic compounds (cyclohexane derivatives and decalins), aromaticity, chemistry of selected heteroelements.

CHEM 2021Y(3) - PHYSICAL CHEMISTRY II AND POLYMER CHEMISTRY I PQ: CHEM 1021Y(1)
Chemical Thermodynamics II: Helmholtz and Gibbs free energy, chemical potential, chemical equilibrium and Le Chatelier's principle, phase equilibria, thermodynamics of electrochemical cells, potential v/s pH diagrams.
Quantum Chemistry II: Particle moving in 2-D and 3-D boxes, particle moving in a ring, 1-D and 3-D harmonic

oscillators, hydrogen and hydrogen-like atoms, operators, perturbation theory and variation method with applications, vector model of atom, introduction to computational methods to solve Schrödinger's equation. Polymer structure and characterization: polymer nomenclature, stereochemistry, isomerism, molar masses and size, size-exclusion chromatography, viscometry, light scattering, thermal analysis, polymer morphology, polymer solubility and thermodynamics of polymer solutions.

CHEM 2031Y(3) - INORGANIC CHEMISTRY II PQ: CHEM 1031Y(1)
Coordination chemistry (nomenclature, coordination numbers and geometries, isomerism in complexes, crystal and ligand field theory, spectrochemical series, molecular orbital theory), further solid state chemistry, stability of complexes, electronic absorption spectra and chemistry of selected transition metals.

CHEM 2041Y(3) - ANALYTICAL CHEMISTRY II PQ: CHEM 1041Y(1)
Sampling and sample preparation, high performance liquid chromatography, chromatographic methods and capillary electrophoresis, electrogravimetric and coulometric analysis, voltammetry.
Chemometrics: Basic statistics, signal processing and time-series analysis, optimisation and experimental design, pattern recognition and classification, modeling.
Quality assurance, legal aspects of chemicals and good laboratory practice.

CHEM 2051Y(3) - PRACTICAL CHEMISTRY IIPR: CHEM 1051Y(1)
Practicals of 150 hours total duration drawn from modules CHEM 2011Y(3), CHEM 2021Y(3), CHEM 2031Y(3) and CHEM 2041Y(3) covering topics in inorganic (40 H), organic (40 H), physical (40 H) and analytical chemistry (30 H).

CHEM 2064Y(3) - TOPICS IN BIOCHEMISTRYPQ: CHEM 1011Y(1)
Biochemistry of amino acids and proteins, bioenergetics, enzymes (structure and kinetics), lipids, DNA, RNA, ATP, carbohydrate metabolism.

CHEM 2065Y(3) - INDUSTRIAL CHEMISTRY PQ: CHEM 1021Y(1)
Topics to be chosen from: industrial metallurgy, inorganic commodity chemicals, synthetic gas processes, textile processing, textile fibres, environmental impacts of chemicals used, enzymatic and non-enzymatic browning in foods, pigments in plants and animals and food colloids.

CHEM 2066Y(3) - COMPUTATIONAL CHEMISTRY PQ: CHEM 1021Y(1)
Computational chemistry: its origin, development, future challenges and limitations, force fields and molecular mechanics, *ab initio* method, semi empirical theory, density functional theory, condensed phase calculations, molecular dynamics, applications.

CHEM 2067Y(3) - ENVIRONMENTAL CHEMISTRY II PQ: CHEM 1041Y(1)
Environmental impact assessment, environmental hazards, ecotoxicity, nutrient cycling, oil spills, mercury contamination, natural and anthropogenic inputs in the coastal zone, ocean resources and seafood, urban smog, ozone kinetics, CFCs, greenhouse effects, air pollution control and monitoring, organic and chlorinated organic pollutants, prohibited chemicals and other selected topics.

CHEM2070Y(3) –FORENSIC CHEMISTRY I
Comparison, analysis and identification of fingerprints, analysis of paint, ink, glass, firearms and gunshot residue, blood, semen, saliva, introductory to DNA analysis.

CHEM 3000Y(5) - PROJECT
Research project approved by the Department and conducted under the supervision of academic(s) from the Department or jointly with other Departments of the University.

CHEM 3011Y(5) - ORGANIC CHEMISTRY III PQ: CHEM 2011Y(3)
Modern organic synthesis (functional group protection, retrosynthetic analysis, rearrangement reactions, chemistry of selected reactive intermediates: carbenes, nitrenes and benzynes, chemistry of advanced heterocycles: quinoline, isoquinoline, indole), introduction to biosynthetic pathways, introduction to physical organic chemistry (nucleophilic substitution).

CHEM 3021Y(5) - PHYSICAL CHEMISTRY III PQ: CHEM 2021Y(3)
Statistical thermodynamics, advanced kinetics, adsorption theories, catalysis, surface chemistry.
Phase equilibria: thermodynamic conditions for phase equilibria, phase rule and its applications to phase diagram, characteristics of phase diagrams involving one, two and three-component systems.
Quantum Chemistry III: Hückel molecular orbital method, group theory and applications to IR and Raman spectroscopy.
Spectroscopy: rotational spectroscopy, vibrational spectroscopy, vibrational-rotational spectroscopy and Raman spectroscopy, their fundamentals and applications, introduction to nanotechnology.

CHEM 3031Y(5) - INORGANIC CHEMISTRY III PQ: CHEM 2031Y(3)
Organometallic chemistry (synthesis, structure and reactivity), magnetochemistry, fluxional molecules, bioinorganic chemistry, reaction mechanisms, chemistry of lanthanides and actinides, descriptive chemistry of some selected transition metals.

CHEM 3064Y(5) - POLYMER CHEMISTRY II PQ: CHEM 2021Y(3)
Methods and techniques for polymer synthesis, polycondensation and step-wise addition polymerization, free-radical, ionic, coordination, metathesis, ring-opening polymerizations, copolymerization, structure-property relationships, commercial and speciality polymers.

CHEM 3065Y(5) - SELECTED TOPICS IN ENVIRONMENTAL AND ANALYTICAL CHEMISTRY
PQ: CHEM 1041Y(1)
Anthropogenic and natural impacts from extractive and petrochemical industries, aquatic chemistry (redox processes, pH and carbonates), coastal and terrestrial pollutants, radioactivity, land contamination and remediation, alternate fuel sources, pollutant transport, transformation and pathways, coastal zone management, natural and human induced hazards.

CHEM 3066Y(5) - QUALITY CONTROL AND QUALITY MANAGEMENT
Laboratory control, ISO standards, HACCP, GLP, accreditation, certification.

CHEM 3067Y(5) - SUPRAMOLECULAR CHEMISTRY
Introduction to supramolecular chemistry, molecular forces, common supramolecules, experimental techniques in supramolecularchemisry, host / guest chemistry, molecular recognition, amphiphile organization, supramolecular design strategy & nanotechnology.

CHEM 3070Y(5) – FORENSIC CHEMISTRY II
Classification and analysis of explosives, the chemistry of fire and identification offire accelerants, methods of detection and identification of drugs and poisons, alcohol analysis.

CSE 1010e(1) - INTRODUCTION TO INFORMATION TECHNOLOGY
IT and computers, stepping in the computer, input and output devices, secondary storage, programming, systems software, applications software, systems development, computer networks, the Internet, computer security, software utilities, issues and trends in IT.