
BSc Degree Program (3 Years)
Subject: Chemistry (CHEM)

Faculty of Science
University of Kelaniya
BSc Degree Program

Subject: Chemistry (CHEM)					
Level	Course Units		Status	Pre-requisite	Co-requisite
University Level 1- Semester 1	CHEM 11601	Calculations in Chemistry ^{1,2}	C/O	-	-
	CHEM 11612	Atomic Structure, Periodic Table and Chemical Bonding	C	G.C.E. A/L Chemistry	-
	CHEM 11622	General Chemistry	C	G.C.E. A/L Chemistry	-
	CHEM 11631	Basic Chemical Analysis Laboratory	C	-	CHEM 11622
University Level 1- Semester 2	CHEM 12642	Physical Chemistry I	C	G.C.E. A/L Chemistry	-
	CHEM 12652	Stereochemistry and Reaction Mechanisms in Organic Chemistry	C	CHEM 11612	-
	CHEM 12661	Basic Organic Chemistry Laboratory	C	-	CHEM 12652
University Level 2- Semester 1	CHEM 21672	Analytical Chemistry	C	CHEM 11622	-
	CHEM 21682	Physical Chemistry II	C	CHEM 12642	-
	CHEM 21691	Physical Chemistry Laboratory	C	CHEM 12642	CHEM 21682
University Level 2- Semester 2	CHEM 22702	Inorganic Chemistry	C	CHEM 11622	
	CHEM 22712	Organic Synthesis, Spectroscopy and Aromaticity	C	CHEM 12652	-
	CHEM 22721	Analytical Chemistry Laboratory	C	CHEM 21672	-
University Level 3- Semester 1	CHEM 31731	Organic and Inorganic Synthesis, Analysis and Natural Products Chemistry Laboratory	C	CHEM 11631, CHEM 12661	-
	CHEM 31742	Material Chemistry and Introduction to Quality Management	O	CHEM 22702	-
	CHEM 31752	Applied Natural Products Chemistry	O	CHEM 22712	-
	PRPL 31992	Professional Placement	O	All CHEM compulsory course units offered in levels 1 and 2	-
University Level 3- Semester 2	CHEM 32762	Environmental Chemistry	O	CHEM 11622, CHEM 21672	CHEM 32771
	CHEM 32771	Environment Chemistry Laboratory	O	CHEM 22721	CHEM 32762
	CHEM 32782	Polymer Chemistry	O	-	-

¹ Credits not counted for the GPA calculation

² Compulsory for biological science stream

University Level 1

Semester	1		
Course Code	CHEM 11601		
Course Name	Calculations in Chemistry		
Credit Value	1		
Compulsory/ Optional	Compulsory/ Optional		
Pre-requisites	-		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	15	-	35
Course Aim/ Intended Learning Outcomes: Upon successful completion of this course unit, the student should be able to, • solve quantitative and qualitative problems related to chemistry using basic mathematical skills			
Course Content: Review of basic mathematics for chemistry: algebraic functions, logarithms, trigonometry, matrices, determinants, coordinate systems, calculus, differential equations. Calculations based on stoichiometry, chemical equilibria, chemical kinetics, thermodynamics, diffractions, electrochemistry and quantum chemistry. Use of graphical methods to solve various chemistry related problems. Use of Excel and scientific calculator for data analysis.			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via Computer Assisted Learning (CAL))			
Assessment Strategy: Continuous assessment and end of course unit examination.			
Details:	Continuous Assessment 20%	Final Assessment 80%	
	Quizzes/ Assignments 20	Theory 80	Practical - Other -
Recommended Reading: 1. Tebbutt, P., (1998) <i>Basic Mathematics for Chemists</i>, John Wiley. 2. Gormally, J., (2000) <i>Essential Mathematics for Chemists</i>, Prentice Hall. 3. Graham, D., (2012) <i>Maths for Chemists</i>, Royal Society of Chemistry.			

Semester	1			
Course Code	CHEM 11612			
Course Name	Atomic Structure, Periodic Table and Chemical Bonding			
Credit Value	2			
Compulsory/ Optional	Compulsory			
Pre-requisites	G.C.E. A/L Chemistry			
Co-requisites	-			
Hourly Breakdown	Theory	Practical	Independent Learning	
	30	-	70	
Course Aim/ Intended Learning Outcomes:				
Upon successful completion of this course unit the student should be able to,				
• explain basic atomic properties using theories of atomic structure • recognize various types of chemical bonding and apply the theories of bonding to predict properties of compounds • explain the periodic trends of physical and chemical properties of the main group, d- block, and f-block elements • compare chemistry of the main group elements with that of d- block and f-block elements				
Course Content:				
Atomic Structure and Chemical Bonding (15 h) Modern view of atomic structure, ionic, covalent, coordinate and metallic bonds. Theories of covalent bonding (valence bond theory and molecular orbital theory of simple polyatomic molecules and ions), intermolecular forces, and lattice structure, crystal structure, unit cell, unit cell types, and band theory of solids.				
Chemistry of Main Group and Transition Elements (15 h) Classification of elements, chemistry of <i>s</i> and <i>p</i> block elements; allotropes, extraction, physical and chemical properties: color, ionization energy, melting point, boiling points, hydration enthalpy, lattice enthalpy, solubility of the salts, reaction with water, reaction with oxygen, reaction with halogens, reaction with liquid ammonia, etc. tendency to form complexes, periodicity of properties, compounds of <i>s</i> and <i>p</i> block elements; hydrides, halides, silicates, oxides, oxoacids, interhalogen compounds, polyhalides, pseudo halides, introduction and properties of <i>d</i> and <i>f</i> - block elements.				
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)				
Assessment Strategy:				
Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-

Recommended Reading:

1. Brown, T. E., LeMay, H. E., Bursten, B.E., Murphy C., Woodward, P., (2014) *Chemistry: The Central Science*, Prentice Hall.
2. Huheey, J. E., Keiter, E., Keiter, R. L., Okhil K. M., (2006) *Inorganic Chemistry*, Pearson.
3. Lee, J.D., (2008) *Concise Inorganic Chemistry*, Blackwell.
4. Weller, M., Overton, T., Rourke, J; Armstrong, F., (2018) *Inorganic Chemistry*, Oxford.

Semester	1			
Course Code	CHEM 11622			
Course Name	General Chemistry			
Credit Value	2			
Compulsory/ Optional	Compulsory			
Pre-requisites	G.C.E. A/L Chemistry			
Co-requisites	-			
Hourly Breakdown	Theory	Practical	Independent Learning	
	30	-	70	
Course Aim/ Intended Learning Outcomes:				
Upon successful completion of this course unit, the student should be able to,				
• use significant figures in the calculations in chemistry • apply basic concepts of solubility, precipitation, and titrations in chemical analysis • describe the activity and decay processes of radioactive isotopes and their properties, effects and reactions				
Course Content:				
Aqueous Solution Chemistry (20 h) Significant figures and scientific notation, error, uncertainty in chemical analysis. Solubility and solubility product, mechanism of precipitation. Gravimetry, Contamination of precipitates; co-precipitation and post precipitation, Purification of precipitates. Titrimetry; Acid-base titrations, buffers. Complexometric titrations; EDTA titrations. Redox titrations; permanganometry, iodometry and iodimetry, dichromate titrations. Precipitation titrations.				
Structure and Reactions of Atomic Nucleus (10 h) Structure of atomic nucleus, radioisotopes, binding energy, nuclear stability, radioactivity and decay, nuclear reactions, effects of radiation on matter, applications of radiation, and radio analytical techniques.				
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)				
Assessment Strategy:				
Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-

Recommended Reading:

1. Harris, D. C., Lucy, C. A., (2020) *Quantitative Chemical Analysis*, Macmillan.
2. Denney, R.C., Mendham J., Bassett J., Jeffery G.H., (2008) *Vogel's Textbook of Quantitative Chemical Analysis*, Pearsons.
3. Weller, M., Overton, T., Rourke, J., Armstrong, F., (2018) *Inorganic Chemistry*, Oxford.
4. Silberberg, M., Amateis, P., (2017) *Chemistry: The Molecular Nature of Matter and Change*, McGraw-Hill Education.

Semester	1				
Course Code	CHEM 11631				
Course Name	Basic Chemical Analysis Laboratory				
Credit Value	1				
Compulsory/ Optional	Compulsory				
Pre-requisites	-				
Co-requisites	CHEM 11622				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit, the student should be able to,					
• adhere to safety rules and good laboratory practice at all times • effectively use basic laboratory techniques for chemical analysis • identify and separate cations and anions in inorganic compounds by standard chemical tests • use titrimetric and gravimetric methods to quantify analytes in aqueous media					
Course Content:					
Laboratory safety, laboratory rules and regulations, handling of chemicals and glassware, basic laboratory techniques; filtration, preparation of solutions, dilution, sample preparation etc. Qualitative analysis of basic cations and anions in inorganic compounds. Quantitative analysis of aqueous analytes; acid base titrations, redox titrations, complexometric titrations and gravimetry.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment, mini project with viva and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory (%)	Practical (%)	Other (%)
	20	10	-	70	-
Recommended Reading:					
1. Reading materials (journal articles related to each experiment) will be provided during the laboratory classes. 2. Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M., Sivasankar, B., (2009) <i>Vogel's Textbook of Quantitative Chemical Analysis</i>. Prentice Hall. 3. Svehla, G., Sivasankar, B., (2012) <i>Vogel's Qualitative Inorganic Analysis</i>, Longmans.					

Semester	2		
Course Code	CHEM 12642		
Course Name	Physical Chemistry I		
Credit Value	2		
Compulsory/ Optional	Compulsory		
Pre-requisites	G.C.E. A/L Chemistry		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to, • apply the concepts, methods and techniques of thermodynamics, kinetics and electrochemistry to chemical systems and make predictions • explain the role of kinetic studies in chemistry across the physical and life sciences and derive rate laws for simple chemical processes from proposed mechanisms • explain the conductivity in terms of ionic motion and apply conductometric measurements for the determination of certain equilibrium constants, endpoints of titrations etc. • assess the activities of chemical species in a solution using Debye-Huckel theory • simplify physical problems by making physically reasonable, justifiable and testable assumptions and develop critical analytical thinking and logical reasoning			
Course Content:			
Thermodynamics (10 h) First law of thermodynamics: work, heat, internal energy, enthalpy, thermochemistry, Second law of thermodynamics: entropy, Gibbs energy, Helmholtz energy, exothermic and endothermic reactions, reactions at equilibrium, temperature dependence of equilibrium constants, effect of concentration, pressure, volume and temperature on the position of equilibrium, Maxwell relations and chemical potentials. Chemical Kinetics (10 h) Basic concepts; rates of reactions, elementary reactions, rate expressions, order and the rate constant of a reaction, molecularity, Experimental determination of rate laws: fitting data to rate laws, obtaining data for different timescales, Introduction to theories about reaction rates: collision theory and activated complex theory. Complex reactions and reaction mechanisms: rate determining steps, pre-equilibrium hypothesis, steady-state approximation and their applications. Temperature dependence of reaction rates: Arrhenius rate law and deviation, Maxwell-Boltzmann distribution, Chain reactions, fast reactions and catalysis. Electrochemistry (10 h) Electrolytic conductance; resistivity, conductivity and molar conductance, molar conductance of ions and Kohlrausch law of independent ionic migration, ionic mobility and ionic conductance, application of measurement of conductance. Ion-ion interaction and activity coefficients. Equilibrium electrochemistry; Nernst equation for equilibrium electrode potentials.			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)			
Assessment Strategy:			

Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-
Recommended Reading: 1. Atkins, P. W., De Paula, J., Keeler, J., (2018) <i>Physical Chemistry</i>, Oxford. 2. Levine, I. N., (2011) <i>Physical Chemistry</i>, McGraw-Hill. 3. Daniels, F., Alberty, R. L., (2004) <i>Physical Chemistry</i>, John Wiley. 4. Barrow, G. M., (1996) <i>Physical Chemistry</i>, McGraw-Hill. 5. McQuarrie, D. A., (1997) <i>Physical Chemistry: A Molecular Approach</i>, University Science Books. 6. Jayasuriya, C., (2016) <i>Basic Chemical Thermodynamics</i>, Stamfordlake.				

Semester	2		
Course Code	CHEM 12652		
Course Name	Stereochemistry and Reaction Mechanisms in Organic Chemistry		
Credit Value	2		
Compulsory/ Optional	Compulsory		
Pre-requisites	CHEM 11612		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to, - draw the structures of isomers and conformers of organic molecules - assign absolute configurations of chiral centers of organic molecules - write IUPAC names for given simple organic compounds and draw structures corresponding to their IUPAC names - identify key organic functional groups and their reactions - predict and rationalize potential reaction mechanisms for selected organic reactions using kinetics and thermodynamics - transform one simple organic functional group to another			
Course Content:			
Stereochemistry (10 h) Isomerism in organic compounds; structural isomers, stereoisomers. Chirality, R and S convention optical activity measurements, chirality of non-mobile conformers and meso compounds. Fisher projections, Newman Projections, Conformational isomers of monocyclic, bicyclic and acyclic alkanes. Mechanistic Aspects of Organic Reactions (5 h) S_N1, S_N2, E1 and E2 mechanisms including their thermodynamic, kinetic aspects and solvent effects. Nomenclature and Reaction Mechanisms of Organic Compounds (15 h) Nomenclature of alkanes, alkenes, alkynes, aldehydes, ketones, alcohols, carboxylic acids, amines and aromatic compounds. Structure, physical properties, synthesis and reactions mechanisms of alkanes (acyclic and bicyclic), alkenes, alkynes, halides, aromatic compounds, alcohols, carbonyl compounds, carboxylic acids, acid derivatives, and amines. Chemistry of reaction intermediates (carbocations, carbanions and radicals).			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)			
Assessment Strategy:			
Continuous assessment and end of course unit examination.			
Details:	Continuous Assessment	Final Assessment	
	20%	80%	

	Quizzes/ Assignments 20	Theory 80	Practical -	Other -
Recommended Reading: 1. Solomons, T. W. G., (2017) <i>Organic Chemistry</i>, John Wiley. 2. Wade, L. G., (2013) <i>Organic Chemistry</i>, Pearson Education. 3. Brown, W. H., (2016) <i>Organic Chemistry</i>, Harcourt Brace. 4. McMurry, J., (2012) <i>Organic Chemistry</i>, Brooks & Cole.				

Semester	2				
Course Code	CHEM 12661				
Course Name	Basic Organic Chemistry Laboratory				
Credit Value	1				
Compulsory/ Optional	Compulsory				
Pre-requisites	-				
Co-requisites	CHEM 12652				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit, the student should be able to,					
• identify functional groups of unknown organic compounds using standard chemical tests • apply techniques to separate, purify, derivatize and characterize organic compounds present in mixtures • identify limiting reagents and calculate theoretical and experimental yields of chemical reactions • perform single step syntheses, isolate and purify products					
Course Content:					
Safety aspects in an organic laboratory.					
Qualitative analysis of functional groups in organic compounds; solubility, tests for unsaturation, alcohols, alkyl halides, ketones, aldehydes, carboxylic acids, phenols, esters, amines (including Hinsberg's test, diazotization, Liebermann's nitroso reaction), nitro compounds, sulphonic acid and amides.					
Purification of organic compounds: recrystallization, determination of melting points and mix melting points, derivatization, separation of mixtures (containing neutral / acid / base / phenol/ salts), simple distillation and fractional distillation.					
Single step syntheses; monitoring the progress of a reaction by TLC; isolation and purification of products; identification of limiting reagent of a reaction, calculation of experimental yield.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory (%)	Practical (%)	Other (%)
	20	10	-	70	-

Recommended Reading:

1. Campbell, B. N., McCarthy, M., (1994) *Organic Chemistry Experiments, Microscale and Semi microscale*, Brooks and Cole Publishing Co.
2. Williamson, K. L., (1989) *Macroscale and Microscale Organic Experiments*, D.C. Heath and Co.
3. Nimitz, J. S., (1990) *Experiments in Organic Chemistry*, Prentice-Hall.

University Level 2

Semester	1		
Course Code	CHEM 21672		
Course Name	Analytical Chemistry		
Credit Value	2		
Compulsory/ Optional	Compulsory		
Pre-requisites	CHEM 11622		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70

Course Aim/ Intended Learning Outcomes:

Upon successful completion of this course unit the student should be able to,

- select the most appropriate sampling technique for a particular analytical experiment
- apply fundamentals of separation techniques (solvent extraction and chromatography), spectroscopy and electro analytical techniques for quantitative chemical analysis

Course Content:

Sampling and Chemometrics (5 h)

Sampling methods, selection of approved analytical methods, development of validation methods, data evaluation and statistical analysis, quality assurance of products analyzed and certifications, intellectual property rights.

Analytical Spectroscopy (8 h)

Emission, absorption, fluorescence and scattering processes of radiation. Atomic emission spectrometry; flame photometry, flame atomic emission spectrometry, inductively coupled plasma atomic emission spectrometry. Atomic absorption spectrophotometry; flame and electro-thermal atomic absorption spectrometry, hydride generation and cold vapor generation techniques. X-ray fluorescence spectrometry. Molecular spectrometry, UV-visible spectrometry, fluorescence spectrometry. Techniques based on the light scattering principle; Nephelometry and turbidimetry.

Analytical Electrochemistry (6 h)

Potentiometry; reference electrodes, indicator electrodes, direct potentiometry, potentiometric titrations, ion selective electrodes, solid state chemical sensors. Voltammetry; classical polarography, two electrode cells, three electrode cells and potentiostats, Tast polarography, pulse polarography, stripping analysis, voltammetry with other working electrodes, cyclic voltammetry and square wave voltammetry. Amperometric titrations. Coulometry; electrogravimetry, constant current and controlled potential coulometry.

Analytical Separation (8 h)

Solvent extraction. An introduction to chromatography; gas chromatography, classical liquid chromatography, high performance liquid chromatography, ion exchange chromatography, molecular exclusion chromatography and affinity chromatography.

Analytical Instrumentation (3 h)

Instrument performance characteristics; instrument calibration, linear range, linear dynamic range, sensitivity, instrument detection limit, method detection limit, limit of quantization. Signal, noise and

signal to noise ratio.

Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)

Assessment Strategy:

Continuous assessment and end of course unit examination.

Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-

Recommended Reading:

1. Skoog, D. A., James, F. H., Nieman, T. A., (2018) *Principles of Instrumental Analysis*, Harcourt Brace College Publishers.
2. Gary, D.C., (1994) *Analytical Chemistry*, John Wiley & Sons, Inc.
3. Kealey, D., Haines, P. J., (2002) *Analytical Chemistry*, BIOS.
4. Miguel V., (2000) *Principles of Analytical Chemistry*, Springer.
5. Skoog, D. A., Donald M. W., James, F. H., (2014) *Fundamentals of Analytical Chemistry*, Saunders College Publishing.
6. Monk, P. M. S., (2001) *Fundamentals of Electroanalytical Chemistry*, Wiley.
7. Robert, de L., (1997) *Principles of Quantitative Chemical Analysis*, McGraw Hill.
8. Skoog, D. A., Donald, M. W., James, F. H., (1994) *Analytical Chemistry: An Introduction*, Saunders College Publishing.
9. Miller J. C., Miller J. N., (1999) *Statistics for Analytical Chemistry*, Ellis Horwood and Prentice Hall.

Semester	1		
Course Code	CHEM 21682		
Course Name	Physical Chemistry II		
Credit Value	2		
Compulsory/ Optional	Compulsory		
Pre-requisites	CHEM 12642		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to, • explain the limitations of classical mechanics and merits of quantum mechanics • apply fundamentals of quantum mechanics to basic chemical models representing translation, rotation and vibration of particles • interpret physical properties of surfaces and colloids using fundamentals • interpret molecular spectra of simple molecules • explain phase equilibria and phase transformations of mixtures using phase diagrams			
Course Content:			
Quantum Mechanics (9 h) Failure of classical mechanics, wave-particle duality, Heisenberg's uncertainty principle, postulates in quantum mechanics, Schrödinger equation, quantum numbers and their significance, particle in infinite potential boxes of 1, 2 and 3 dimensions, rotation in 2-dimension, harmonic oscillator and the hydrogen atom.			
Surface and Colloid Chemistry (6 h) Introduction to the fundamental and applications of interfacial phenomena; capillarity, surface and interfacial tension, wetting and contact angles, chemical and physical adsorption. Gas-solid adsorption; Langmuir and Freundlich isotherms, Colloids; classification and preparation; properties of colloidal dispersion.			
Atomic and Molecular Spectroscopy (9 h) Interaction of electromagnetic radiation with matter. Rotational spectroscopy; rigid rotor model. vibrational spectroscopy; harmonic and anharmonic oscillator models. Raman spectroscopy and electronic spectroscopy, Spectroscopic term symbols.			
Phase Equilibria (6 h) Thermodynamical description of mixtures, partial molar quantities; partial molar volume and Gibbs free energy. Phases, components and degree of freedom, the phase rule, phase diagrams; interpretation, lever rule. Liquid-liquid phase diagrams; phase separation, critical solution temperatures. Temperature-composition diagrams; distillation of mixtures, zeotropes and azeotropes. Liquid solid phase diagrams; eutectics and three component systems.			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)			

Assessment Strategy:				
Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-
Recommended Reading:				
1. Atkins, P. W., De Paula, J., Keeler, J., (2018) <i>Physical Chemistry</i>, Oxford. 2. Levine, I. N., (2011) <i>Physical Chemistry</i>, McGraw-Hill. 3. Daniels, F., Alberty, R. L., (2004) <i>Physical Chemistry</i>, John Wiley. 4. Barrow, G. M., (1996) <i>Physical Chemistry</i>, McGraw-Hill. 5. Hollas, M., (2002) <i>Basic Atomic and Molecular Spectroscopy</i>, RSC. 6. Monk, P. M. S., (2001) <i>Fundamentals of Electroanalytical Chemistry</i>, Wiley.				

Semester	1				
Course Code	CHEM 21691				
Course Name	Physical Chemistry Laboratory				
Credit Value	1				
Compulsory/ Optional	Compulsory				
Pre-requisites	CHEM 12642				
Co-requisites	CHEM 21682				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit, the student should be able to,					
• measure physico-chemical properties and evaluate data using fundamental concepts of physical chemistry • properly operate some basic laboratory equipment and use instrumental techniques in chemical analysis • use standard mathematical analyses to correctly explain the numerical significance of experimental results					
Course Content:					
Instrumental techniques for determination of physicochemical properties based on chemical equilibrium, thermodynamics, chemical kinetics, spectroscopy, and electrochemistry. Use of statistical methods for the analysis of experimental data and disciplinary reporting of results.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory	Practical	Other
	20	10	-	70	-
Recommended Reading:					
1. Shoemaker, D. P., Garland, G. W., Nibler, J. W., (2002) <i>Experiments in Physical Chemistry</i> , McGraw-Hill.					

Semester	2			
Course Code	CHEM 22702			
Course Name	Inorganic Chemistry			
Credit Value	2			
Compulsory/ Optional	Compulsory			
Pre-requisites	CHEM 11622			
Co-requisites	-			
Hourly Breakdown	Theory	Practical	Independent Learning	
	30	-	70	
Course Aim/ Intended Learning Outcomes:				
Upon successful completion of this course unit the student should be able to,				
• name coordination compounds systematically according to IUPAC nomenclature • draw the structures of the different types of isomers of coordination compounds • explain magnetic properties, colors, hybridizations, geometries, and distortions of coordination complexes using the bonding theories of coordination compounds • explain the involvement of electrons in metal-ligand bonding • propose mechanisms for simple catalytic processes involving organometallic compounds • identify the symmetry and point groups of molecules				
Course Content:				
Coordination Chemistry (14 h) History, isomerism and nomenclature of coordination compounds, Lewis theory, valence bond theory, crystal field theory. Applications of crystal field theory; colors, magnetic properties etc., spectrochemical series, factors affecting the crystal field splitting, Jahn-Teller distortion, introduction of ligand field theory.				
Organotransition Metal Chemistry (10 h) Importance of organometallic chemistry, organometallic ligands. Formalisms in organometallic chemistry; oxidation state, <i>d</i> electron configuration, number of valence electrons, metal–carbon bonding, bonding properties of H ₂ , carbon monoxide, alkenes, alkyne and N ₂ . Reactivity of organometallic compounds, mechanisms for simple catalytic processes.				
Molecular Symmetry (6 h) Symmetry elements, symmetry operations, determination of molecular symmetry and point groups.				
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)				
Assessment Strategy:				
Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-

Recommended Reading:

1. Miessler, G. L., Fischer, P. J., Tarr, D.A., (2014), *Inorganic Chemistry*, Pearson.
2. Crabtree, R. H., (2013) *The Organometallic Chemistry of the Transition Metals*, Wiley.
3. Lee, J. D., (2008) *Concise Inorganic Chemistry*, Blackwell.
4. Weller, M., Overton, T., Rourke, J., Armstrong, F., (2018) *Inorganic Chemistry*, Oxford.
5. Cotton, F. A., Wilkinson, G., Murillo, C. A, Bochmann, M., (2007) *Advanced Inorganic Chemistry*, New York, John Wiley.
6. Sharp, A. G., Housecroft, C., (2012) *Inorganic Chemistry*, Pearson.

Semester	2		
Course Code	CHEM 22712		
Course Name	Organic Synthesis, Spectroscopy and Aromaticity		
Credit Value	2		
Compulsory/ Optional	Compulsory		
Pre-requisites	CHEM 12652		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to, • construct C-C and C-N bonds using efficient synthetic methods • construct simple organic molecules employing suitable methods, reagents and reaction conditions • interpret spectra of simple organic compounds • determine the structure of simple organic compounds by analyzing spectra • identify aromatic compounds and rationalize their stability			
Course Content:			
Organic Synthesis (10 h) Carbon-carbon single bond formation; carbonyl condensations, inter and intra molecular condensations, specific enolates, base promoted alkylations. Carbon- carbon double bond formation; Wittig reaction. The use of organometallics in synthesis; Mg and Cu reagents. Carbon-nitrogen bond formation, use of rearrangements in synthesis; Baeyer Villiger and Claisen rearrangements. Functional group transformations in synthesis including oxidation and reduction.			
Spectroscopic Methods in Structure Elucidation of Organic Chemistry (15 h) Electromagnetic spectrum and organic molecules; UV and visible spectroscopy, molecular orbital description, color of compounds, chromophores, solvent effects, Beer Lambert's law, UV spectrometer. Infra-red spectroscopy; stretching frequencies of functional groups, effects of hydrogen bonding, IR spectrometer and experimental considerations. ¹H-Nuclear magnetic resonance spectroscopy; theory, secondary magnetic fields, chemical shift values of aliphatic and aromatic compounds, including annulenes, chemical equivalence, peak area measurement and integration, spin-spin splitting, effect of hydrogen bonding, D₂O exchange, NMR spectrometer and experimental considerations. ¹³C-NMR; theory, chemical shift assignments, effect of neighboring protons, proton coupled ¹³C-NMR spectrum, off resonance decoupled spectra, experimental considerations. Mass spectroscopy; theory, mass spectrometer and mass spectrum, molecular ion and fragmentation patterns of compounds, use of molecular formula, N-rule, high resolution mass spectra. Interpretation of the spectra of organic compounds.			
Aromaticity and Aromatic Heterocyclic Compounds (5 h) Aromatic character; application of Hückel's rule, Frost circles, aromatic hydrocarbon ions, annulenes. antiaromatic hydrocarbons. Introduction to aromatic heterocyclic compounds: nomenclature, structure and physical and chemical properties of five, six, and bicyclic heteroaromatic compounds with one			

heteroatom.

Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)

Assessment Strategy:

Continuous assessment and end of course unit examination.

Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-

Recommended Reading:

1. Norman, R. O. C., Coxon J.M., (1993) *Principles of Organic synthesis*, Chapman & Hill.
2. Pavia, D. L., Lapman, G. M., Kriz, G. S., (1979) *Introduction to Spectroscopy*, Saunders.
3. Williams, D.H., (1989) *Spectroscopic Methods in Organic Chemistry*, McGraw and Hill.
4. Murphy, P., (2002) *Heterocyclic Chemistry; Series: Tutorial Chemistry Texts*. M. Sainsbury, University of Bath.

Semester	2				
Course Code	CHEM 22721				
Course Name	Analytical Chemistry Laboratory				
Credit Value	1				
Compulsory/ Optional	Compulsory				
Pre-requisites	CHEM 21672				
Co-requisites	-				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit, the student should be able to,					
- perform an appropriate sampling technique prior to chemical analysis - apply the best analytical technique for an unknown sample to be characterized chemically - validate the analytical method and data obtained by chemometric techniques - identify, differentiate and demonstrate the classical and instrumental methods of chemical analysis					
Course Content:					
Experiments based on sampling and data handling, gravimetric analysis of metals using homogeneous precipitation method, complexometric titration of metal mixtures. Experiments based on analytical spectrometry; atomic absorption spectrometry, flame photometry and colorimetry. Electroanalytical techniques; voltammetry, potentiometry, separation techniques; solvent extractions, ion exchange chromatography, basic GC and LC methods. Method development and validation.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory	Practical	Other
	20	10	-	70	-
Recommended Reading:					
- Skoog, D. A., James F. H., Nieman. T. A., (1998) <i>Principles of Instrumental Analysis</i>, Harcourt Brace College Publishers. - Skoog, D. A., Donald M. W., James, F.H., (1996) <i>Fundamentals of Analytical Chemistry</i>, Saunders College Publishing. - Harris, D. C., (2006) <i>Quantitative Chemical Analysis</i>, Freeman. - Mendham, J., Denney, R. C., Barnes, J. D., (2002) <i>Vogel's Textbook of Quantitative Chemical Analysis</i>, Prentice Hall.					

University Level 3

Semester	1				
Course Code	CHEM 31731				
Course Name	Organic and Inorganic Synthesis, Analysis and Natural Products Chemistry Laboratory				
Credit Value	1				
Compulsory/ Optional	Compulsory				
Pre-requisites	CHEM 11631, CHEM 12661				
Co-requisites	-				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit the student should be able to,					
• synthesize and isolate air-stable coordination complexes • analyze the isolated purified complexes by titrimetric and spectrophotometric methods • solve problems and plan schemes related to the analysis of coordination complexes • learn effective communication of scientific results by scientific report writing • isolate natural products using hot and cold extraction techniques • separate natural products using chromatographic techniques • interpret the UV, IR, NMR, and mass spectra of simple organic compounds and determine the structure using these spectra • perform single/multi step syntheses, isolate and purify products					
Course Content:					
Inorganic Synthesis and Analysis Laboratory (24 h) Synthesis of inorganic complexes, isolation, purification and analysis by titrimetric, spectrophotometric methods (UV-Visible Spectrophotometry, Infrared Spectrophotometry and Nuclear Magnetic Resonance Spectrometry) and conductivity measurements. Mini-project/ group presentations/ Industrial visit.					
Natural Products, Organic Spectroscopy and Synthesis (21 h) Isolation of natural products; steam distillation, cold and hot extraction, Separation; chromatographic techniques: column and TLC and analysis of natural products. Structure elucidation of simple organic compounds by the use of spectroscopy; ¹ H NMR, ¹³ C NMR, MS, FTIR and UV. Synthesis of simple organic compounds via Diels-Alder reaction and Aldol condensation, and characterization of products. Multistep syntheses.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory	Practical	Other

	20	10	-	70	-
Recommended Reading:					
1. Reading materials (journal articles related to each experiment) will be provided during the laboratory classes. 2. Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M., Sivasankar, B., (2009) <i>Vogel's Textbook of Quantitative Chemical Analysis</i>. Prentice Hall. 3. Campbell, B. N., McCarthy, M., (1994) <i>Organic Chemistry Experiments, Microscale and Semimicroscale</i>, Brooks and Cole Publishing Co. 4. Wickramarachchi, S., (2018) <i>Structure Elucidation of Organic Compounds Using Spectroscopy: A Work Book, Problems and Answers</i>, College of Chemical Sciences.					

Semester	1			
Course Code	CHEM 31742			
Course Name	Material Chemistry and Introduction to Quality Management			
Credit Value	2			
Compulsory/ Optional	Optional			
Pre-requisites	CHEM 22702			
Co-requisites	-			
Hourly Breakdown	Theory	Practical	Independent Learning	
	30	-	70	
Course Aim/ Intended Learning Outcomes:				
Upon successful completion of this course unit the student should be able to, - describe the importance of the earth resources in chemical industry - identify different inorganic materials and their industrial uses - explain processing and utilization procedures of various materials, minerals and crude petroleum - validate methods and data, quality assurance of products and concept of intellectual property rights				
Course Content:				
Inorganic Material and Nanomaterials Chemistry (9 h) Structures, preparation, properties and applications of silicones, zeolites and biomaterials. Introduction to Nanotechnology, Synthesis of nanomaterials, their properties and applications				
Minerals and Metallurgy (10 h) Chemistry and identification of mineral resources; ores and deposits, physiochemical properties and uses of minerals and deposits of commercial value. Mineral sands, appetite, dolomite, graphite, quartz and mica. Introduction to extraction of metals; hydrometallurgical, pyrometallurgical and electrometallurgical methods.				
Petroleum Chemistry (5 h) Petroleum deposits, cracking processes, separation and refining processes.				
Quality Management, Intellectual Property and Green Chemistry (6 h) Introduction to quality management, basic norms of intellectual property law, rationale and policy underlying intellectual property law, overview of green chemistry and cleaner production.				
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)				
Assessment Strategy: Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment		Final Assessment	
	20%		80%	
	Quizzes/ Assignments		Theory	Practical

	20	80	-	-
Recommended Reading: 1. Schubert, U., Husong, N., (2019) <i>Synthesis of Inorganic Materials</i>, VCH. 2. Buchel, K. H., Moretto, H. H., Woditsch, P., (2008) <i>Industrial Inorganic Chemistry</i>, VCH. 3. Mark, J. E., Allcock, H. R., West, R., (2005) <i>Inorganic Polymers</i>, OXFORD. 4. James, A. K., (1993) <i>Riegel's Handbook of Industrial Chemistry</i>, Kluwer. 5. Barry, A. W., (1997) <i>Mineral Processing Technology</i>, Pergamon Press. 6. Lancaster, M., (2002) <i>Green Chemistry</i>, RSC.				

Semester	1		
Course Code	CHEM 31752		
Course Name	Applied Natural Products Chemistry		
Credit Value	2		
Compulsory/ Optional	Optional		
Pre-requisites	CHEM 22712		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to, • recognize the major classes of natural products and describe their unique characteristics • explain the basic biosynthetic pathway of the above classes of natural products • explain various extraction, separation and identification techniques • describe the importance of the natural products in industry • explain the development of new pharmaceuticals, biopesticides and nutraceuticals			
Course Content:			
Chemistry of Natural Products (10 h) Link between primary and secondary metabolites, Diversity and classification: Terpenes, steroids, alkaloids, polyketides, phenyl propanoids, flavonoids etc. Structural features and properties and biosynthesis of major classes of natural products; Pharmaceutical, ayurvedic and agricultural interests of natural products; antibiotics, antioxidants, anti-inflammatory, anti-cancer, anti-glycemic compounds. Methodologies in Extraction, Separation and Identification of Natural Products (10 h) Traditional and modern extraction methods: Steam distillation, hot and cold extraction techniques, Soxhlet extraction, supercritical fluid extraction, microwave assisted extraction, accelerated solvent extraction, Fractionation techniques of bioactive natural products: Chromatographic techniques: LC-MS, GC-MS, EAG, GC-EAG in identification of natural products, Bioassay guided fractionation, Bioassay methods; antimicrobial, antioxidant, anti-inflammatory, insecticidal bioassays etc. Applications of Natural Products (10 h) Perfumery, herbal health products, quality control and standardization of herbal drugs, Drug development, Nutraceuticals and functional food, Biopesticides, Semiochemicals and integrated pest management.			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)			
Assessment Strategy:			
Continuous assessment and end of course unit examination.			
Details:	Continuous Assessment	Final Assessment	
	20%	80%	

	Quizzes/ Assignments 20	Theory 80	Practical -	Other -
Recommended Reading: 1. Mann J., Davidson, R. S., Hobbs, J. B., Banthorpe, D. V., Harbone, J. B., (1996) <i>Natural Products: Their Chemistry and Biological Significance</i>, Longman. 2. Voelter, W., Daves, D. G., (1984) <i>Biologically Active Principles of Natural Products</i>. Georg ThiemeVerlag. 3. Szantay, C. S., (1984) <i>Chemistry and Biotechnology of Biologically Active Natural Products</i>, Elsevier.				

Semester	1		
Course Code	PRPL 31992		
Course Name	Professional Placement		
Credit Value	2		
Compulsory/ Optional	Optional		
Pre-requisites	All CHEM compulsory course units offered in levels 1 and 2		
Co-requisites	-		
Hourly Breakdown	Theory	Practical	Independent Learning
	-	-	100
Course Aim/ Intended Learning Outcomes: Upon successful completion of this course unit the student should be able to, • use laboratory skills in industrial applications and accumulate work place skills that will help them in their future careers			
Course Content: The students will be placed in selected industries and institutions where they carryout chemistry related work/research for a period of six weeks. The required resource materials will be supplied by the relevant institution/industry.			
Teaching/ Learning Methods: Training under the supervision and guidance of research/ industrial personnel			
Assessment Strategy: Oral presentation and report			
Details:	Trainer's reports 20%	Trainee's reports 60%	Trainee's oral presentations 20%

Semester	2		
Course Code	CHEM 32762		
Course Name	Environmental Chemistry		
Credit Value	2		
Compulsory/ Optional	Optional		
Pre-requisites	CHEM 11622, CHEM 21672		
Co-requisites	CHEM 32771		
Hourly Breakdown	Theory	Practical	Independent Learning
	30	-	70
Course Aim/ Intended Learning Outcomes:			
Upon successful completion of this course unit the student should be able to,			
• explain the importance of the environmental chemistry • describe the fundamentals in atmospheric, aquatic and soil chemistry • identify and recognize sources, reactions and fate of chemical pollutants in the environment • explain the importance of waste minimization and waste management			
Course Content:			
Atmospheric Chemistry (8 h)			
Importance of atmosphere, components of atmosphere, chemical and photochemical reactions, air pollution and chemistry of air pollutants, enhanced greenhouse effect, photochemical smog, ozone layer depletion, acid rain, minimization of air pollution.			
Aquatic Chemistry (8 h)			
Various bodies of water, their characterization and significance, interactions between water and air, interactions between water and soil, chemical transformations, water quality, water pollution, waste water and wastewater treatment.			
Soil Chemistry (8 h)			
Soil formation, soil minerals and organic matter, surface charges of soil clay particles, soil profile and texture, acidity, alkalinity and salinity of soil, cation exchange capacity (CEC) and base saturation, soil salinity, soil water, soil air and nutrients & their availability.			
Pollution and Waste Management (6 h)			
Waste and pollutants in atmosphere, hydrosphere, and geosphere, treatment and disposal of waste and waste minimization.			
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)			
Assessment Strategy:			
Continuous assessment and end of course unit examination.			
Details:	Continuous Assessment	Final Assessment	
	20%	80%	
	Quizzes/ Assignments	Theory	Practical
			Other

	20	80	-	-
Recommended Reading: 1. Manahan, S., (2017) <i>Environmental Chemistry</i>, CRC. 2. Finlayson-Pitts, B. J., (1999) <i>Chemistry of the Upper and Lower Atmosphere</i>, Academic Press. 3. McBride, M. B., (1994) <i>Environmental Chemistry of Soils</i>, Oxford. 4. Evangelou, V. P., (1998) <i>Environmental Soil and Water Chemistry. Principle and Applications</i>, John Wiley. 5. Harrison, R. M., (1999) <i>Understanding Our Environment: An Introduction to Environmental Chemistry and Pollution</i>, RSC.				

Semester	2				
Course Code	CHEM 32771				
Course Name	Environment Chemistry Laboratory				
Credit Value	1				
Compulsory/ Optional	Optional				
Pre-requisites	CHEM 22721				
Co-requisites	CHEM 32762				
Hourly Breakdown	Theory	Practical	Independent Learning		
	-	45	05		
Course Aim/ Intended Learning Outcomes:					
Upon successful completion of this course unit, the student should be able to,					
- describe common sources of atmospheric, soil and water pollutants - develop skills necessary to identify and quantify soil, water and air pollutants					
Course Content:					
Soil analysis; phosphates, total nitrogen, ammonia, water soluble chlorides, sulfate and metal ions, soil acidity, alkalinity, cation exchange capacity (CEC) and total organic matter. Water analysis; total solids, conductance, hardness, pH, COD, BOD, oil, grease, dyes, surfactants and other heavy metals. Air analysis; sampling and determination of the levels of NOx and other pollutants in the air. Analysis of food preservatives and bleach samples.					
Teaching/ Learning Methods: A 3-hour laboratory class per week (15 weeks), pre lab quizzes and assignments					
Assessment Strategy:					
Continuous assessment and end of semester examination.					
Details:	Continuous Assessment		Final Assessment		
	30%		70%		
	Quizzes/ Assignments	Lab reports	Theory	Practical	Other
	20	10	-	70	-
Recommended Reading:					
1. Fifield, F. F., Hanes, P. J., (2000) <i>Environmental Analytical Chemistry</i> , Blackwell.					
2. Kebbekus, B. B., Mitra, S., (2000) <i>Environment Chemical Analysis</i> , Chapman & Hall/CRC.					
3. Boehnke, D. N., Delumyea, R.D., (2000) <i>Laboratory Experiments in Environmental Chemistry</i> , Prentice Hall.					

Semester	2			
Course Code	CHEM 32782			
Course Name	Polymer Chemistry			
Credit Value	2			
Compulsory/ Optional	Optional			
Pre-requisites	-			
Co-requisites	-			
Hourly Breakdown	Theory	Practical	Independent Learning	
	30	-	70	
Course Aim/ Intended Learning Outcomes:				
Upon successful completion of this course unit the student should be able to,				
- propose methods for polymer synthesis, their identification, and investigation of properties - predict the properties of polymers through structure-property relationships - summarize industrially important polymers, their structures, polymerization processes and applications - explain various chemical processes involved in polymer related industries in Sri Lanka and apply the knowledge in polymer-related product manufacturing				
Course Content:				
Various classifications of polymers, polymer synthesis, characterization and properties. Industrially important polymers: structure, preparation, characterization and properties, structure-property relationships, Polymer- related industries: dry rubber- based and latex-based industries, paints, surface coatings and adhesives, plastics industry, soaps and detergents. Environmental effects of polymers: degradation and stabilization.				
Teaching/ Learning Methods: A combination of lectures and tutorial discussions (supporting materials will be provided via CAL)				
Assessment Strategy:				
Continuous assessment and end of course unit examination.				
Details:	Continuous Assessment	Final Assessment		
	20%	80%		
	Quizzes/ Assignments	Theory	Practical	Other
	20	80	-	-
Recommended Reading:				
- Ravve, A., (1995) <i>Principles of Polymer Chemistry</i>, Plenum. - Billmeyer, F. W., (1984) <i>Textbook of Polymer Science</i>, John Wiley. - Seymour, R.D., Carraher, Jr. E.R., (1992) <i>Polymer Chemistry; An Introduction</i>, Marcel Dekker Inc. - Young, R. J., Lovell, P. A., (2011) <i>Introduction to Polymer Chemistry</i>, CRC Press.				