PRINCIPAL SUBJECT AREA

CHEMISTRY

Compulsory courses for the General degree: CH 101, CH 102, CH 108, CH 109**,** CH 211, CH 218, CH 221, CH 228, CH 231, CH 238, CH 328, CH 331, CH 338, CH 348

Compulsory courses for the Special Degree: CH 101, CH 102, CH 108, CH 109, CH 211, CH 212, CH 218, CH 221, CH 222, CH 228, CH 231, CH 232, CH 238, CH 317, CH 319,CH 321, CH 324, CH 326, CH 329, CH 330, CH 331, CH 332, CH 339, CH 341, CH 342, CH 351, CH 369, CH 416, CH 417, CH 425, CH 426, CH 435, at least two out of (CH 436, CH 437, 438), CH 443, CH 448, CH 455, CH 491, CH 492, CH 499.

300 LEVEL COURSES

CH 316 Special Topics in Inorganic Chemistry (2 credits)
(Prerequisite: CH 211) ***Recommended for Chemistry (Special) students***
Chemistry of the transition elements; Lanthanides; Actinides; Transuranium compounds; Rare Earths: Chemistry and extraction (15 L).
Silicates; Boranes; Metal clusters; Intercalates and their applications (15 L).

Recommended Texts:

1. DF Shriver, PW Atkins and CH Langford (1991), *Inorganic Chemistry*, ELBS with Oxford university press.
2. James E. Huheey (1994), *Inorganic Chemistry.*
3. FA Cotton and G.Wilkinson (1997) *Advanced Inorganic Chemistry,* Wiley Inter science.

CH 317 Advanced Inorganic Chemistry (3 credits)
(Prerequisite: CH 211)
***Symmetry*:** Symmetry elements, symmetry operations, classification of molecules/ions according to their symmetry; point groups; determination of point groups of molecules/ions, deduction of polarity and optical activity of molecules from their point group, group multiplication, basis, representative and matrix representation, character of an operation, character tables, reducible and irreducible representations (10 L).
***Spectroscopic Methods*:** NMR, NQR, ESR, Mossbauer, spectroscopy and inorganic applications (10 L).
***Advanced Co-ordination Chemistry*:** Ligand field theory, electronic spectra of complexes, magnetochemistry (15 L)
Diffraction Methods: General aspects of diffraction mechanism, generation of X-rays, Bravais lattices, reciprocal lattices, translational symmetry operations, space groups, systematic absences and space group determination, atomic scattering factors, structure factors, Fourier and Patterson maps, structure determination and refinement using single crystal XRD data, and applications; Neutron diffraction; Electron diffraction. (10 L)

Recommended Texts:

1. FA Cotton (1990), *Chemical Applications of Group Theory*; Oxford university Press, UK.
2. RS Drago (1965), *Physical Methods in Inorganic Chemistry*, Oxford university Press, UK.
3. DF Shriver, PW Atkins and CH Langford (1994) *Inorganic Chemistry*, Oxford University Press;

CH 319 Advanced Inorganic Chemistry Laboratory (2 credits)
(Prerequisites: CH 218)
Analysis of rare earths, insoluble mixtures, magnetic measurements, X-ray diffraction, UV-visible spectra of transition metal complexes, synthesis of special inorganic compounds.

Recommended Texts:

1. A.I. Vogel, *Qualitative Inorganic Analysis* (2004), Longman Scientific

CH 321 Chemistry of Biomolecules (1 credit)
(Prerequisite CH 221)
Reactions and properties of monosaccharides, structures of disaccharides and polysaccharides; Properties and reactions of amino acids, structure and synthesis of peptides (10 L). Introduction to the chemistry and biosynthesis of flavonoids, terpenoids, steroids and alkaloids (5 L)

Recommended Texts:
1. RJ Fessenden and JS Fessenden (1990) *Organic Chemistry* Brooks/Cole Publishing Co.
2. RT Morrison and RN Boyd (1998) *Organic Chemistry*, Prentice Hall
3. FA Carey and RK Sundberg (1989) *Advanced Organic Chemistry, Part A*, Plenum Press

CH 324 Organic Chemistry II (2 credits)
(Prerequisites: CH 221, CH 222)
Organic Reaction Mechanisms II (15 L): Reactive intermediates –reactions of free radicals, carbenes and nitrenes; Symmetry controlled reactions; Electrocyclic reactions, cycloadditions and sigmatropic rearrangements. Reactions of carbocyclic and heterocyclic aromatic compounds.
Organic Synthesis II (15 L); Reterosynthetic analysis - disconnection, functional group interchange, transform, synthons, synthetic reagents; Chemoselectivity, regioselectivity, stereoselectivity and stereospecificilty; Types of disconnections- one group and two group disconnections; Amine synthesis; Strategies and control in carbonyl condensation- 1,3-dicabonyl compounds, □-hydroxy carbonyl compounds, □,□-unsaturated carbonyl compounds, specific enolates, intramolecular aldol reaction, 1,5 - dicarbonyl compounds; Strategies in ring synthesis ; Free radicals in organic synthesis

Recommended Texts:
1. S Ege. (1994) *Organic Chemistry,* DC Heath and Co.
2. RT Morrison and RN Boyd (1998) *Organic Chemistry*, Prentice Hall.
3. EJ Corey and X-M Cheng (1989) *The Logic of Chemical Synthesis*, John Wiley;
4. RK Mackie and DM Smith (1990) *Guidebook to Organic Synthesis*, Addison, Wesley and Longman.

CH 326 Advanced Organic Chemistry I (2 credits)
(Prerequisite: CH 221)
Conformational Analysis (15 L): Conformations of simple acyclic molecules, alkenes, carbocyclic ring systems (6-membered rings, 3,4 and 5-membered rings, large rings), Conformational analysis. Conformation and reactivity, Rules for ring closure, Stereo-electronic effects in organic compounds (15 L); Advanced stereochemistry (10 L); Pericyclic reactions (5 L)
Spectroscopy II (15L) – 2D NMR, MS and GC-MS, ORD-CD (15 L)

Recommended Texts:
1. EL Eliel and SH Wilen (1994) *Stereochemistry of Organic Compounds,* John Wiley & Sons Inc;
2. GM Loudon (1995);
3. RM Silverstein, GC Bassler and TC Morrill (1991) *Spectrometric Identification of organic compounds*, John Wiley and Sons.

CH 328 Organic Chemistry Laboratory II (1 credit)
(Prerequisite: CH 228)
Synthesis of organic compounds, . Isolation and characterisation of natural products, Application of spectroscopic methods for structure determination of organic compounds.

Recommended Texts:
1. AI Vogel , (1989) *Elementary Practical Organic Chemistry. Part A*, Longman Scientific
2. RM Silverstein, GC Bassler and TC Morrill (1991) *Spectrometric Identification of Organic Compounds*; John Wiley & Sons
3. RJ Fessenden and JS Fessenden (1990), *Organic Chemistry* Brooks; Cole Publishing Co.
4. RT Morrison and RN Boyd (1998) *Organic Chemistry*, Prentice Hall
5. FA Carey and RK Sundberg (1989) *Advanced Organic Chemistry, Part A*, Plenum Press

CH 329 Advanced Organic Chemistry Laboratory (2 credits)
(Prerequisite: CH 228)
Microscale preparation of organic compounds, multistep syntheses; Application of spectroscopic methods for structure determination of organic compounds. (only for Chemistry special students)

Recommended Texts:
1. RM Silverstein, GC Bassler and TC Morrill (1991), *Spectrometric Identification of Organic Compounds*, John Wiley & Sons
2. AI Vogel, (1989*), A Textbook of Practical Organic Chemistry*, Longman Scientific.

CH 330 Advanced Physical Chemistry I (3 credits)

(Prerequisites: CH 232, CH 331)

Quantum Mechanics (15 L): Quantum mechanical models: Review of the particle-in-a-box model, simple harmonic oscillator, rigid rotator, the H-atom, eigen value relationships for observables; Approximate methods: Variation and perturbation theories, the He-atom; Electron spin and the Pauli principle, Slater determinants, spin magnetic moment. Many electron atoms: Atomic units, Hartree-Fock equations and the self-consistent field method, antisymmetric wave functions, Slater determinants, Hartree-Fock-Roothaan method, correlation energy, atomic term symbols; Molecules and Born-Oppenheimer approximation; Quantum mechanical interpretation of molecular orbital and valence bond theories.

Advanced Molecular Spectroscopy (15 L): Spectral line widths and intensities, Microwave spectroscopy; Rigid and non-rigid rotor systems; Symmetric-top molecules; Spectra of isotopes; Vibrational spectroscopy; Harmonic and Anharmonic Oscillators, Fundamentals, Overtones, Combination bands, hot bands; Vibrational-Rotational Spectroscopy: diatomic and polyatomic molecules; Raman Spectroscopy; Determination of molecular structure; Electronic Spectroscopy; Vibrational and Rotational fine structure, Franck – Condon principle.

Statistical Thermodynamics (15 L): Boltzmann distribution, molecular partition functions, canonical ensemble, canonical partition function, translational, rotational, vibrational and electronic partition functions. Statistical entropy, Sackoor-Tetrode equation, calculation of thermodynamic functions from partition function data, equipartition principle and mean energy, calculation of heat capacity, residual entropy and equilibrium constants, equlibrium composition.

Recommended Texts:

1. PW Atkins and Julio de Paula, (2006), *Physical Chemistry*, Freeman and Co., New York.
2. WJ Moore, *Introduction to Molecular Spectroscopy*
3. DA McQuarrie, (1983), *Quantum Chemistry*, University Science Books.

CH 331 Physical Chemistry II (2 credits)

(Prerequisite: CH 231)

Advanced Thermodynamics (10L): Specific applications of the first law and second law of thermodynamics, free energy functions, criteria for spontaneity, fundamental equations of thermodynamics, open systems; temperature dependence of internal energy and enthalpy, Joule-Thompson coefficients, inversion temperature, general relationships between C_p and C_v. third law, third law entropies, reaction entropies; Temperature dependence of Gibb's function, Gibbs-Helmhlotz equation; Pressure dependence of Gibb's function, chemical potential of gases, real gases and fugacity, standard state of gas; Real solutions, activities, solvent and solute activities; Equilibrium constants for rear gases, response of equilibrium constants to catalysts.

Surface and Colloid Chemistry (10 L): Interfaces and surfaces; Kelvin equation and its applications; Adsorption and absorption, surface excess; Physisorption and chemisorption, adsorption at liquid/gas, solid/gas interfaces, measurement of amount of adsorption, Gibbs and Langmuir adsorption isotherms; Enthalpy of adsorption; Dispersion systems; Surfactants and their uses.

Phase Equilibria (10 L): The phase rule, meaning of phase, component, one component systems and their phase diagrams; Two-component systems, liquid-liquid phase diagrams, distillation of partially miscible liquids, liquid-solid phase diagrams; Phase diagrams for reactive systems; Ultra purity and controlled purity; Three component systems, triangular phase diagrams.

Recommended Texts:

1. PW Atkins and Julio de Paula, (2006), *Physical Chemistry*, Freeman and Co., New York.
2. M Campbell, *Catalysis at Surfaces*.

CH 332 Physical Chemistry III (1 credit)

(Prerequisite: CH 231)

Kinetics: Steady-state approximation, pre-equilibrium, enzyme catalyzed reactions, the kinetics of complex reactions, catalysis.

Polymer Chemistry: Introduction to polymers, polymerization process, Carother's equation for linear and non-linear step-growth polymerization, kinetics of addition and step-growth polymerization; Melting point and glass transition temperature; Relationship between chemical structure and properties of polymers; Statistical thermodynamics of polymer solutions; Characterization of polymers.

Recommended Texts:

1. PW Atkins and Julio de Paula, (2006), Physical Chemistry, Freeman and Co., New York.
2. RJ Young and PA Lovell***, Introduction to polymer,*** Oxford University Press

CH 338 Physical Chemistry Laboratory II (1 credit)
(Prerequisite: CH 238)
Experiments in physical chemistry: Electrochemistry, chemical kinetics, spectroscopy.

Recommended Texts:
1. DP Shoemaker, CW Garland, JW Nibler (1996), *Experiments in Physical Chemistry*;
2. A Findlay, *Findlay's Practical Physical Chemistry*; Revised Edition, Oxford University Press.
3. P Mathews (1985), *Experimental Physical Chemistry*; Oxford University Press

CH 339 Advanced Physical Chemistry Laboratory II (2 credits)
(Prerequisite: CH 238)
Experiments in advanced physical chemistry: Electrochemistry, kinetics, spectroscopy.

Recommended Texts:
1. DP Shoemaker, CW Garland, JW Nibler (1996) *Experiments in Physical Chemistry*;
2. A Findlay, *Findlay's Practical Physical Chemistry*; Revised Edition, Oxford University Press.
3. P Mathews (1985), *Experimental Physical Chemistry*; Oxford University Press.

CH 341 Analytical Chemistry (3 credits)
(Prerequisite: CH 231)
Advanced Calculations (12 L): Review of statistics in chemical analysis: test of significance, paired t-test, F-test, etc.; Statistics of linear chemical relationships; Performance characteristics of analytical methods; Interlaboratory testing; Sensor characteristics; Advanced calculations as applied to chemical analysis: derivation and error calculations associated with acid-base, redox and complexometric titrations; Iteration methods; metal-complex equilibria; Solubility equilibria and Gran plots.
Analytical Aspects of Spectrophotometry (9 L): Atomic absorption and emission methods, molecular uv and visible absorption spectroscopy.
Electroanalytical Chemistry (12 L): Potentiometric applications; voltammetry including polarographic methods, pulsed techniques, steady-state and flow injection amperometric methods, bulk electrolysis methods, microelectrodes in chemical analysis, electrochemical sensors,
Separation Methods (12 L): Solvent extraction, partition coefficient, distribution ratio, multiple extractions, extraction of metals, introduction to chromatographic techniques and classifications, gas chromatography, van-Deemter equation, ion-exchange chromatography, thin layer and paper chromatography, introduction to liqiuid-liquid chromatography.

Recommended Texts:
1. DA Skoog, West and Holler (2005), *Analytical Chemistry*; Marcel Dekker.
2. P Kissinger and WR Heineman (1984) *Laboratory Techniques in Electroanalytical Chemistry*; Freeman.
3. Marcel Dekker; AJ Bard and L Faulkner (1980), *Electrochemical Methods*; Marcel Dekker.

CH 342 Computer Applications and Instrumentation (2 credits)
(Prerequisite CH 231). Maximum of **60** students will be allowed to register including chemistry special students. Selection of the general degree students will be based on the **GPA**. *Not allowed for those who have been offered CS 206)*
Introduction to computers: Number systems (decimal, binary, octal and hexadecimal) Logic gates: Combinational and sequential logic, de Morgan's theorems, Flip flops, counters, Shift registers, Computer memory organisation, Analog to digital conversion (ADC), Data acquisition and Instrument control, Programming exercises, Plotting of radial wave functions, atomic and molecular orbitals, hybridisation)

Recommended Texts:
1. P Horowitz and W Hill,(1989), *The Art of Electronics*, Cambridge University Press

CH 348 Analytical and Inorganic Chemistry Laboratory (1 credit)
(Prerequisite: CH 218)
Inorganic preparations, colorimetry, applications of physical methods to study inorganic reactions, quantitative analytical methods.

Recommended Texts:
1. WL Jolly, *Inorganic preparations*.

CH 351 Biological Chemistry I (2 credits)
(Prerequisite: CH 321; Not allowed for those who have completed MB 201, MB 221 or BT 204.)
Metabolism (15 L) Metabolism of amino acids, carbohydrates, lipids and nucleic acids
Enzymology (15 L): Enzymes as catalysts in biological systems, structure, classification and nomenclature of enzymes; Mode of enzyme action; Enzyme kinetics; Regulatory enzymes; Applications of enzyme technology in industry; Enzyme systems and human health

Recommended Texts:
1. A Lehninger, DL Nelson and MM Cox (1993), *Principles of Biochemistry*, Worth Publishers Inc.
2. L Stryer (1995) *Biochemistry* WH Freeman and Co.

CH 361 Environmental Chemistry (3 credits)
(Prerequisites: CH 211, CH 221)
Theory Component (30 L): Chemical cycles, aquatic chemistry, water pollution, water treatment, water quality standards. Atmospheric chemistry, particles in the atmosphere Air pollution- inorganic and organic air pollutants, particles in the atmosphere, photochemical smog, global warming, acid rain, depletion of the ozone layer. Municipal and solid waste and their management, hazardous waste, waste as a resource; Pollution prevention and control, clean production mechanism; Environmental biochemistry; Toxicology; Environmental monitoring and analysis, sampling, classical methods and instrumentation; Analysis of data.
Laboratory Component (30 hr): Analysis of water quality parameters, analysis of air pollutants and particles; detection of pesticides.

Recommended Texts:
1. SE Manahan, (1994) *Environmental Chemistry,* Lewis publishers
2. C Baird (2000), *Environmental Chemistry*

CH 369 Industrial Training (1 credit)
Each student following the chemistry special degree is required to undergo a six week training programme at an industry/institution identified by the Department.

CH 371 Industrial Chemistry (3 credits)
(Prerequisites: CH 221,CH 231)
Metallurgy, minerals of Sri Lanka, industrial inorganic chemistry, coal, petroleum, essential oils, polymers, dyes, pharmaceuticals, intellectual property rights, elementary chemical engineering, mass transfer, heat transfer, reactors.

Recommended Texts:
1. PG Cooray (1964*) Geology of Sri Lanka*, Ceylon Museum
2. Industrial organic Chemistry by V, Karunaratne, Publisher :Science Education Unit, Faculty of Science, University of Peradeniya