

## NATIONAL DIPLOMA: ANALYTICAL CHEMISTRY (Extended curriculum programme with foundation provision) Qualification code: NDACF1 - NQF Level 6

Campus where offered: Arcadia Campus (day classes)  
Last year of new intake: 2018  
Teach-out (phase-out) date: 31 December 2024

Students registered for this qualification should complete their studies according to the teach-out date prescribed for the qualification, subject to the stipulations of Regulation 3.1.11 and 3.1.13 in the Students' Rules and Regulations.

Information on phased-out programmes can be obtained from the TUT website, [www.tut.ac.za](http://www.tut.ac.za).

Key to asterisks:

\* Information does not correspond to information on AA72.

(Deviations approved Senate in May 2012 and September 2015.)

### CURRICULUM

Consult the 2018 Faculty Prospectus for the full contents of the qualification.

#### FIRST YEAR

Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
FPCHE04	Chemistry IA: Extended*	(0,200)	
FPMAT06	Mathematics I: Extended*	(0,183)	
FPPHU05	Physics IA: Extended*	(0,184)	

#### FIRST SEMESTER

FPENG05	Foundation English	(0,100)	
FPLSK02	Foundation Life Skills	(0,100)	

#### SECOND SEMESTER

ANC101T	Analytical Chemistry I	(0,100)	
CSK101B	Computer Skills I	(0,083)	

TOTAL CREDITS FOR THE FIRST YEAR: **0,950**

#### SECOND YEAR

Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
<b>FIRST SEMESTER</b>			
AHP201T	Analytical Chemistry: Practical II	(0,100)	Analytical Chemistry I Chemistry IA: Extended Computer Skills I
ANC251T	Analytical Chemistry II	(0,100)	Mathematics I: Extended Analytical Chemistry I Chemistry IA: Extended Computer Skills I
ICH231T	Inorganic Chemistry II	(0,100)	Mathematics I: Extended Chemistry IA: Extended Foundation English



OCH221T	Organic Chemistry II	(0,100)	Chemistry IA: Extended Foundation English
PCB221T	Physical Chemistry II	(0,100)	Mathematics I: Extended Chemistry IA: Extended Foundation English

TOTAL CREDITS FOR THE SEMESTER: 0,500

### SECOND SEMESTER

ENC201T	Environmental Chemistry II	(0,100)	Chemistry IA: Extended Foundation Life Skills
ICH321T	Inorganic Chemistry III	(0,100)	Inorganic Chemistry II Computer Skills I
OCH321T	Organic Chemistry III	(0,100)	Foundation Life Skills Inorganic Chemistry II Computer Skills I
PCB321T	Physical Chemistry III	(0,100)	Foundation Life Skills Organic Chemistry II Computer Skills I

TOTAL CREDITS FOR THE SEMESTER: 0,400

TOTAL CREDITS FOR THE SECOND YEAR: **0,900**

### THIRD YEAR

Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
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#### FIRST SEMESTER

AHP311T	Analytical Chemistry: Practical III	(0,150)	Analytical Chemistry II Analytical Chemistry: Practical II
ANC321T	Analytical Chemistry III	(0,100)	Analytical Chemistry II
CQA201T	Chemical Quality Assurance	(0,100)	Analytical Chemistry II Analytical Chemistry: Practical II

#### SECOND SEMESTER

One of the following options:

##### Option 1

ENC301T	Environmental Chemistry III	(0,100)	Environmental Chemistry II
EPS101B	Entrepreneurial Skills	(0,100)	
IBA201T	Industrial Chemical Analysis	(0,100)	Analytical Chemistry I
MAT271T	Mathematics II	(0,100)	Mathematics I: Extended
PHU201T	Physics II	(0,100)	Physics IA: Extended

##### Option 2

EXP1ACH	Work-Integrated Learning* (this subject and Chemistry Project III may not be taken during the same semester, except with the permission from the Head of the Department)	(0,300)	Analytical Chemistry III Analytical Chemistry: Practical III
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TOTAL CREDITS FOR THIRD YEAR (OPTION 1): **0,850**

TOTAL CREDITS FOR THIRD YEAR (OPTION 2): **0,650**



**FOURTH YEAR**

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
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**FIRST SEMESTER****One of the following options:****Option 1**

EXP1ACH	Work-Integrated Learning* (this subject may not be taken with any other subject during the same semester, except with the permission from the Head of the Department)	(0,300)	Analytical Chemistry III Analytical Chemistry: Practical III
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**Option 2**

CPJ311T	Chemistry Project III	(0,500)	Analytical Chemistry III Analytical Chemistry: Practical III
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TOTAL CREDITS FOR FOURTH YEAR (OPTION 1):	<b>0,300</b>
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TOTAL CREDITS FOR FOURTH YEAR (OPTION 2):	<b>0,500</b>
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TOTAL CREDITS FOR THE QUALIFICATION:	<b>3,000</b>
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**SUBJECT INFORMATION (OVERVIEW OF SYLLABUS)**

The syllabus content is subject to change to accommodate industry changes. Please note that a more detailed syllabus is available at the Department or in the study guide that is applicable to a particular subject. On 01 August 2018, the syllabus content was defined as follows:

**A**

**ANALYTICAL CHEMISTRY I (ANC101T) 1 X 3-HOUR PAPER**  
(Subject custodian: Department of Chemistry)

Laboratory practice and safety in analytical chemistry. Elementary statistics, significant digits. Precision and accuracy. Sampling and sample preparation. Introduction to classical analysis. Writing technical reports. Practical: relevant practical work. (Total tuition time: ±136 hours)

**ANALYTICAL CHEMISTRY II (ANC251T) 1 X 3-HOUR PAPER**  
(Subject custodian: Department of Chemistry)

Gravimetric analysis. Precipitation titrations. Neutralisation titrations. Non-aqueous titrations. Complex formation titrations. Redox titrations. Analytical separations. Refractometry and polarimetry. (Total tuition time: ± 72 hours)

**ANALYTICAL CHEMISTRY III (ANC321T) 2 X 2-HOUR PAPER**  
(Subject custodian: Department of Chemistry)

Atomic spectroscopy: Introduction to X-ray (XAS and XAF), flame atomic absorption (FAAS), flame atomic emission spectrometry (FAES), inductively coupled plasma atomic emission (ICP-AES) and electrical discharge (arc and spark) atomic emission spectrometry. Sources and correcting interferences in AAS. Instrumentation, applications and quantitative analysis using XAS, XAF, AAS and AES. Molecular spectroscopy: Introduction to UV-Vis and IR spectroscopy. Instrumentation, applications and quantitative analysis using UV-Vis spectrophotometry. Chromatography: High-performance liquid chromatography (HPLC) and gas chromatography (GC), instrumentation, migration rates of solutes, zone broadening and column efficiency, optimisation of column performance, applications, qualitative and quantitative analysis. Electroanalysis: Potentiometry, reference electrodes, indicator electrodes, membrane indicator electrodes, applications of potentiometry. (Total tuition time: ± 120 hours)

**ANALYTICAL CHEMISTRY: PRACTICAL II (AHP201T) CONTINUOUS ASSESSMENT**  
(Subject custodian: Department of Chemistry)

"Wet" chemical analysis. Basic instrumental analysis. (Total tuition time: ± 96 hours)



**ANALYTICAL CHEMISTRY: PRACTICAL III (AHP311T)****PRACTICAL EXAMINATION****(Subject custodian: Department of Chemistry)**

Practical experiments of potentiometric titrations, pH measurements, gas chromatography, liquid chromatography, flame emission spectrometry, flame atomic absorption spectrometry, UV/VIS and infrared molecular spectroscopy, refractometry and polarometry. (Total tuition time: ± 128 hours)

**C****CHEMICAL QUALITY ASSURANCE (CQA201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Collection of data, sampling systems, errors and advanced statistical treatment of data in analytical chemistry, including ANOVA. Optimisation and calibration of analytical instruments. Quality assurance systems, including ISO. Laboratory accreditation. (Total tuition time: ± 48 hours)

**CHEMISTRY IA: EXTENDED (FPCHE04)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Scientific methodology and its use in discovering chemistry. Numbers in chemistry. The use of SI units. Matter. Atomic structure. Compounds in chemistry. The mole concept and chemical calculations. The electronic structure of the atom and electronic configurations within the periodic table. Chemical bonding. The states of matter and the binding forces within matter. Basic concepts of the gas laws. Solutions in chemistry. Acids, bases and salts. Oxidation and reduction and the balancing of equations. Introduction to organic compounds (nomenclature and functional groups). (Total tuition time: ± 192 hours)

**CHEMISTRY PROJECT III (CPJ311T)****CONTINUOUS ASSESSMENT****(Subject custodian: Department of Chemistry)**

Practical experience in experiential techniques in a chemical laboratory. (Total tuition time: Determined per individual - Research)

**COMPUTER SKILLS I (CSK101B)****CONTINUOUS ASSESSMENT****(Subject custodian: End User Computing Unit)**

Students have to acquire theoretical knowledge (computing fundamentals) and practical skills as an end-user in operating systems and MS Office Suite applications (MS Word, MS Excel and MS PowerPoint) on an introductory level. Students will do online and computer based tests. The modules are mapped with SAQA and IC3 Essential Skills for Digital Literacy (international certification). (Total tuition time: ± 40 hours)

**E****ENTREPRENEURIAL SKILLS (EPS101B)****1 X 3-HOUR PAPER****(Subject custodian: Department of Management and Entrepreneurship)**

Types of businesses. Management functions. Planning, organising, guidance and control. Budgeting. Accounting. Administration. Banking. Personnel management. Customer relations. (Total tuition time: ± 45 hours)

**ENVIRONMENTAL CHEMISTRY II (ENC201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Chemical fate and transport, industrial ecology, aquatic chemistry, including water analysis, sources of water pollution and water treatment methods. Chemical analysis of water and wastewaters. Toxicological chemistry. Practical: experimental techniques related to the theory. (Total tuition time: ± 96 hours)

**ENVIRONMENTAL CHEMISTRY III (ENC301T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

The geosphere and geochemistry: rock cycle, sediment transport and pollution issues relating to the geosphere. Soil chemistry: composition of soil and chemical reactions that may occur in soil. Atmospheric chemistry: atmospheric physical and chemical processes, particularly the photochemical process, as well as various effects from dispersion of pollutants, sampling and analytical methods relating to atmospheric or gaseous samples. Waste: nature and sources of waste, waste minimisation at source, disposal of waste, hazardous waste, nuclear waste and agricultural chemicals. Waste and solids analysis: methods for sampling and analysis of solid environmental samples including wastes. Practical: experimental techniques related to the theory. (Total tuition time: ± 96 hours)



**F****FOUNDATION ENGLISH (FPENG05)****1 X 3-HOUR PAPER****(Subject custodian: Department of Applied Languages)**

Interpret, relate and reflect on all available and relevant resource material in proper English. Communicate orally in a comprehensible and clear manner in both general and subject-specific communication. Demonstrate intermediate-level of proficiency in written English. (Total tuition time: ± 160 hours)

**FOUNDATION LIFE SKILLS (FPLSK02)****CONTINUOUS ASSESSMENT****(Subject custodian: Department of Management and Entrepreneurship)**

Campus ethics, learning styles and whole-brain thinking, self-image and assertive behaviour, time management, self-motivation, conflict management, sexuality and relationships, problem-solving skills, managing stress, the multicultural society, techniques for summarising and memorising, how to cope with assessments and assignments, creativity, and many more. The life-skills sessions are participative, with group discussions and personal application to optimise student's learning experience. (Total tuition time: ± 128 hours)

**I****INDUSTRIAL CHEMICAL ANALYSIS (IBA201T)****CONTINUOUS ASSESSMENT****(Subject custodian: Department of Chemistry)**

Any five of the following: chemical analysis in complex matrices, drug analysis in biological fluids, analysis in the brewing industry, air pollution analysis, sealants and adhesives, chemical analysis of animal feed and human food, water, metallurgical, polymer and sugar analyses. (Total tuition time: ± 48 hours)

**INORGANIC CHEMISTRY II (ICH231T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Introduction to chemical bonding and an advanced study of ionic bonding. Chemical reactions in aqueous and non-aqueous solutions. Redox chemistry. Interpretation of oxidation state diagrams. Descriptive inorganic chemistry. (Total tuition time: ± 72 hours)

**INORGANIC CHEMISTRY III (ICH321T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Bonding and the structure of molecules. Coordination chemistry. Crystal field theory. Transition elements. The first transition metal series: Sc to Ni. The chemistry of Group IB: Cu, Ag, Au. Group IIB: Zn, Cd, Hg. Practical inorganic chemistry. (Total tuition time: ± 112 hours)

**M****MATHEMATICS I: EXTENDED (FPMAT06)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mathematics and Statistics)**

Basic mathematics. Differentiation. Integration. Matrices. (Total tuition time: ± 120 hours)

**MATHEMATICS II (MAT271T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Mathematics and Statistics)**

Differentiation: logarithmic differentiation, implicit functions, the inverse of trigonometric functions, the hyperbolic functions, parametric functions, applications. Partial differentiation: first-order partial derivatives, small increments, rates of change, changing of the variables, errors. Integration: fundamental integration formulae, factor integration, partial fractions, hyperbolic functions, standard forms, applications. First-order differential equations: introduction and definitions, direct integration, separation of variables, exact equations, linear equations, Bernoulli's equation, applications. (Total tuition time: ± 120 hours)

**O****ORGANIC CHEMISTRY II (OCH221T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Nomenclature and reactions of alkenes and alkynes, introduction to stereochemistry and conformational analysis; benzene and its derivatives, syntheses and reactions of alkyl halides. Syntheses and reactions of alcohols and ethers. Syntheses and reactions of ketones and aldehydes, Syntheses of carboxylic acids and their derivatives. Syntheses and reactions amines. Qualitative experiments in organic chemistry. (Total tuition time: ± 104 hours)



**ORGANIC CHEMISTRY III (OCH321T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Introduction to spectroscopic methods of analyses and structure elucidation of organic molecules (UV, IR, MS, H-NMR), further reactions of benzene, further reactions of carbonyl compounds, carbohydrates and amino acids. Practical organic chemistry. (Total tuition time:  $\pm$  112 hours)

**P****PHYSICAL CHEMISTRY II (PCB221T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Gases (ideal and non-ideal). Liquid surface tension, viscosity, additive properties. Chemical kinetics. Chemical equilibrium. Colloids. Colligative properties of solutions. Electrochemistry. (Total tuition time:  $\pm$  72 hours)

**PHYSICAL CHEMISTRY III (PCB321T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Chemistry)**

Chemical thermodynamics – first, second and third laws. Changes of phase diagrams. Electrochemical, conductivity, transport numbers, electrolysis. Reaction kinetics orders, Arrhenius equation, composite mechanisms, catalysis. Quantum chemistry, atomic spectra, emission and absorption spectra, rotational spectra, Raman, vibrational and electronic spectra. The solid-state crystal lattice, planes, indices, X-ray, diffraction, structure of crystals. Surface chemistry, adsorption isotherms, surface reactions. Practical: physical chemistry. (Total tuition time:  $\pm$  112 hours)

**PHYSICS IA: EXTENDED (FPPHU05)****1 X 3-HOUR PAPER****(Subject custodian: Department of Physics)**

Basic mathematics for physics. Introduction to calculus-based physics. Measurements. Kinematics in 1D and 2D. Newton's laws of motion. Dynamics of uniform circular motion. Work energy and power. Impulse and momentum. Rotational kinematics and dynamics. Fluids, temperature and heat. The ideal gas law and kinetic theory. Electric forces and fields. Electric potential energy and the electric potential. Electric circuits. Reflection of light: mirrors, lenses and optical instruments. Practical experiments related to the theory with emphasis on measuring physical quantities. (Total tuition time:  $\pm$  160 hours)

**PHYSICS II (PHU201T)****1 X 3-HOUR PAPER****(Subject custodian: Department of Physics)**

Electronics, nuclear physics, electric and magnetic fields and forces, spectroscopy, properties of electromagnetic waves, quantum mechanics. Practical: experiments related to the theory. (Total tuition time:  $\pm$  75 hours)

**W****WORK-INTEGRATED LEARNING (EXP1ACH)****WORK-INTEGRATED LEARNING****(Subject custodian: Department of Chemistry)**

This project should be conducted with the cooperation of the student's employer, and must include one or more of the following: the pharmaceutical industry, soaps and detergents, pulp and paper, sugar and starch, dyestuffs, Portland cement, calcium and magnesium compounds, surface coating, fermentation, petroleum and petrochemicals, agrichemicals, chemicals and chemical processes in ore processing, applications of analytical techniques, mining, iron and steel, water and sewage treatment. (Total tuition time: 40 hours a week multiplied by six months)

