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.

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.

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CREDIT</th>
<th>PREREQUISITE SUBJECT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPCHE04</td>
<td>Chemistry IA: Extended*</td>
<td>(0,200)</td>
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<tr>
<td>FPMAT06</td>
<td>Mathematics I: Extended*</td>
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<td>FPPHU05</td>
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FIRST SEMESTER

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<tr>
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<tbody>
<tr>
<td>FPENG05</td>
<td>Foundation English</td>
<td>(0,100)</td>
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<tr>
<td>FPLSK02</td>
<td>Foundation Life Skills</td>
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SECOND SEMESTER

<table>
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<tr>
<th>CODE</th>
<th>Subject</th>
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<th>PREREQUISITE SUBJECT(S)</th>
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<tbody>
<tr>
<td>ANC101T</td>
<td>Analytical Chemistry I</td>
<td>(0,100)</td>
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</tr>
<tr>
<td>CSK101B</td>
<td>Computer Skills I</td>
<td>(0,083)</td>
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TOTAL CREDITS FOR THE FIRST YEAR: 0,950

SECOND YEAR
Subjects are offered in both semesters.

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
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<th>PREREQUISITE SUBJECT(S)</th>
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<tbody>
<tr>
<td>AHP201T</td>
<td>Analytical Chemistry: Practical II</td>
<td>(0,100)</td>
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<tr>
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<td>Computer Skills I</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Mathematics I: Extended</td>
</tr>
<tr>
<td>ANC251T</td>
<td>Analytical Chemistry II</td>
<td>(0,100)</td>
<td>Analytical Chemistry I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chemistry IA: Extended</td>
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<td></td>
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<td>Computer Skills I</td>
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<td></td>
<td></td>
<td></td>
<td>Mathematics I: Extended</td>
</tr>
<tr>
<td>ICH231T</td>
<td>Inorganic Chemistry II</td>
<td>(0,100)</td>
<td>Chemistry IA: Extended</td>
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<td></td>
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<td></td>
<td>Foundation English</td>
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</tbody>
</table>
OCH221T  Organic Chemistry II  (0,100) Chemistry IA: Extended
Mathematics I: Extended
Foundation English

PCB221T  Physical Chemistry II  (0,100) 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
Foundation Life Skills

OCH321T  Organic Chemistry III  (0,100) Organic Chemistry II
Computer Skills I
Foundation Life Skills

PCB321T  Physical Chemistry III  (0,100) Physical Chemistry II
Computer Skills I
Foundation Life Skills

TOTAL CREDITS FOR THE SEMESTER: 0,400

TOTAL CREDITS FOR THE SECOND YEAR: 0,900

THIRD YEAR
Subjects are offered in both semesters.

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CREDIT</th>
<th>PREREQUISITE SUBJECT(S)</th>
</tr>
</thead>
</table>
| AHP311T | Analytical Chemistry: Practical III  (0,150) | Analytical Chemistry II  
Analytical Chemistry: Practical III |
| ANC321T | Analytical Chemistry III  (0,100) | Analytical Chemistry II  
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

<table>
<thead>
<tr>
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<tbody>
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<td>ENC301T</td>
<td>Environmental Chemistry III  (0,100)</td>
<td>Environmental Chemistry II</td>
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<td>EPS101B</td>
<td>Entrepreneurial Skills  (0,100)</td>
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<tr>
<td>IBA201T</td>
<td>Industrial Chemical Analysis  (0,100)</td>
<td>Analytical Chemistry I</td>
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<tr>
<td>MAT271T</td>
<td>Mathematics II  (0,100)</td>
<td>Mathematics I: Extended</td>
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<tr>
<td>PHU201T</td>
<td>Physics II  (0,100)</td>
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Option 2

<table>
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<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CREDIT</th>
<th>PREREQUISITE SUBJECT(S)</th>
</tr>
</thead>
</table>
| EXP1ACH | Work-Integrated Learning*   (0,300) | Analytical Chemistry III  
Analytical Chemistry: Practical III |

(this subject and Chemistry Project III may not be taken during the same semester, except with the permission from the Head of the Department)

TOTAL CREDITS FOR THIRD YEAR (OPTION 1): 0,850
TOTAL CREDITS FOR THIRD YEAR (OPTION 2): 0,650
### FOURTH YEAR

<table>
<thead>
<tr>
<th>CODE</th>
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<td><strong>FIRST SEMESTER</strong></td>
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<tr>
<td></td>
<td><strong>One of the following options:</strong></td>
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<tr>
<td></td>
<td><strong>Option 1</strong></td>
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<tr>
<td>EXP1ACH</td>
<td>Work-Integrated Learning*</td>
<td>(0,300)</td>
<td>Analytical Chemistry III</td>
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<td></td>
<td>(this subject may not be taken with any other subject during the same semester, except with the permission from the Head of the Department)</td>
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<td>Analytical Chemistry: Practical III</td>
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<tr>
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<td><strong>Option 2</strong></td>
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<tr>
<td>CPJ311T</td>
<td>Chemistry Project III</td>
<td>(0,500)</td>
<td>Analytical Chemistry III</td>
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<td>Analytical Chemistry: Practical III</td>
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<td><strong>TOTAL CREDITS FOR FOURTH YEAR (OPTION 1):</strong></td>
<td></td>
<td><strong>0,300</strong></td>
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<td></td>
<td><strong>TOTAL CREDITS FOR FOURTH YEAR (OPTION 2):</strong></td>
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<td><strong>0,500</strong></td>
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<td><strong>TOTAL CREDITS FOR THE QUALIFICATION:</strong></td>
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<td><strong>3,000</strong></td>
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</table>

### 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)**

*(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)**

*(Subject custodian: Department of Chemistry)*


**ANALYTICAL CHEMISTRY III (ANC321T)**

*(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)**

*(Subject custodian: Department of Chemistry)*

"Wet" chemical analysis. Basic instrumental analysis. (Total tuition time: ± 96 hours)
ANALYTICAL CHEMISTRY: PRACTICAL III (AHP311T)

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)

CHEMICAL QUALITY ASSURANCE (CQA201T)

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)


CHEMISTRY PROJECT III (CPJ311T)

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

COMPUTER SKILLS I (CSK101B)

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)

ENTREPRENEURIAL SKILLS (EPS101B)


ENVIRONMENTAL CHEMISTRY II (ENC201T)

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)

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)
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)

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)

INORGANICCHEMISTRY 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)

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)

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: ± 112 hours)

PHYSICAL CHEMISTRY II (PCB221T) 1 X 3-HOUR PAPER

(Subject custodian: Department of Chemistry)


PHYSICAL CHEMISTRY III (PCB321T) 1 X 3-HOUR PAPER

(Subject custodian: Department of Chemistry)


PHYSICS IA: EXTENDED (FPPHU05) 1 X 3-HOUR PAPER

(Subject custodian: Department of Physics)


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: ± 75 hours)

WORK-INTEGRATED LEARNING (EXP1ACH) 1 X 3-HOUR PAPER

(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)