NATIONAL DIPLOMA: ANALYTICAL CHEMISTRY
Qualification code: NDAC03 - NQF Level 6

Campus where offered: Arcadia Campus

Important notification to new applicants:
Students who intend to enrol for this qualification for the first time in 2017 or thereafter, should note that it will not be possible to continue with any Baccalaureus Technologiae as from 2020, since it is being replaced by qualifications aligned with the newly-implemented Higher Education Qualification Sub-Framework. Potential students are advised to consult the University's website for any new qualifications which might not be published in this Prospectus.

REMARKS

a. *Admission requirement(s) and selection criteria:*

- **FOR APPLICANTS WHO OBTAINED A SENIOR CERTIFICATE BEFORE 2008:**

  Admission requirement(s):
  A Senior Certificate or an equivalent qualification, with an E symbol at Higher Grade or a D symbol at Standard Grade for English, Mathematics and Physical Science.

  Selection criteria:
  Applicants who meet these minimum requirements will be considered for admission to the National Diploma or the National Diploma (Extended Curriculum). Applicants' performance in the Senior Certificate will determine whether they will be registered for the National Diploma or for the National Diploma (Extended Curriculum).

- **FOR APPLICANTS WHO OBTAINED A NATIONAL SENIOR CERTIFICATE IN OR AFTER 2008:**

  Admission requirement(s):
  A National Senior Certificate with a bachelor's degree or a diploma endorsement, or an equivalent qualification, with an achievement level of at least 4 for English (home language or first additional language), 4 for Mathematics and 4 for Physical Sciences.

  Selection criteria:
  To be considered for this qualification, applicants must have an Admission Point Score (APS) of at least **21**.

  Assessment procedures:
  Applicants who meet the minimum requirements will be considered for admission to the National Diploma or the National Diploma (Extended Curriculum). An applicant's performance in the National Senior Certificate will determine whether they will be registered for the National Diploma or for the National Diploma (Extended Curriculum).

b. *Minimum duration:*
Three years.

c. *Presentation:*
Day classes.

d. *Intake for the qualification:*
January only.

e. *Exclusion and readmission:*
See Chapter 2 of Students' Rules and Regulations.

f. *Recognition of Prior Learning (RPL), equivalence and status:*
See Chapter 30 of Students' Rules and Regulations.

g. *Practicals:*
It is compulsory for students to attend 100% of the practical classes. Students must pass the practical component of a subject to be admitted to the examination.

h. *Textbooks:*
Textbooks and other educational material will be required.

i. *Personal protective equipment:*
Specific safety wear is compulsory (where applicable), and students must purchase it themselves.

j. *Work-Integrated Learning:*
See Chapter 5 of Students' Rules and Regulations.

k. *Subject credits:*
Subject credits are shown in brackets after each subject.

Key to asterisks:
* Information does not correspond to information in Report 151.
(Deviations approved by the Senate in August 2005.)

CURRICULUM

FIRST YEAR
Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
FIRST SEMESTER			
ANC101T	Analytical Chemistry I	(0,125)	
CHE141B	Chemistry IA	(0,125)	
CSK101B	Computer Skills I	(0,083)	
MAT171T	Mathematics I	(0,083)	
PHU161B	Physics IA (first semester subject only)	(0,084)*	
TOTAL CREDITS FOR THE SEMESTER:		0,500	
SECOND SEMESTER			
AHP201T	Analytical Chemistry: Practical II	(0,100)	Analytical Chemistry I Chemistry IA
ANC251T	Analytical Chemistry II	(0,100)	Analytical Chemistry I Chemistry IA
ICH231T	Inorganic Chemistry II	(0,100)	Chemistry IA
OCH221T	Organic Chemistry II	(0,100)	Chemistry IA
PCB221T	Physical Chemistry II	(0,100)	Chemistry IA
TOTAL CREDITS FOR THE SEMESTER:		0,500	
TOTAL CREDITS FOR THE FIRST YEAR:		**1,000**	

SECOND YEAR
Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)
FIRST SEMESTER			
ENC201T	Environmental Chemistry II	(0,083)*	Chemistry IA
ICH321T	Inorganic Chemistry III	(0,139)	Inorganic Chemistry II

OCH321T	Organic Chemistry III	(0,139)	Organic Chemistry II
PCB321T	Physical Chemistry III	(0,139)	Physical Chemistry II

TOTAL CREDITS FOR THE SEMESTER: 0,500

SECOND SEMESTER

AHP311T	Analytical Chemistry: Practical III	(0,200)	Analytical Chemistry II Analytical Chemistry: Practical II
ANC321T	Analytical Chemistry III	(0,200)	Analytical Chemistry II
CQA201T	Chemical Quality Assurance	(0,100)	Analytical Chemistry II Analytical Chemistry: Practical II

TOTAL CREDITS FOR THE SEMESTER: 0,500

TOTAL CREDITS FOR THE SECOND YEAR: **1,000**

THIRD YEAR
Subjects are offered in both semesters.

CODE	SUBJECT	CREDIT	PREREQUISITE SUBJECT(S)

FIRST 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 II
MAT271T	Mathematics II	(0,100)	Mathematics I
PHU201T	Physics II	(0,100)	Physics IA

Option 2

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)	(0,500)	Analytical Chemistry III Analytical Chemistry: Practical III

SECOND SEMESTER

One of the following options:

Option 1

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)	(0,500)	Analytical Chemistry III Analytical Chemistry: Practical III

Option 2

CPJ311T	Chemistry Project III	(0,500)	Analytical Chemistry III Analytical Chemistry: Practical III

TOTAL CREDITS FOR THE THIRD YEAR: **1,000**

TOTAL CREDITS FOR THE QUALIFICATION: **3,000**

SUBJECT/MODULE 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/module. On 01 August 2017, 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 (CHE141B) **1 X 3-HOUR PAPER**
(Subject custodian: Department of Chemistry)
Atomic structure, chemical bonding, periodic table of elements and nomenclature of inorganic compounds. Chemical equations and reactions and stoichiometry. Solutions, acids, bases, pH calculations and chemical equilibrium. Electrochemistry and redox reactions. Introduction to organic compounds (nomenclature and functional groups). Practical: experiments based on the theory, with the emphasis on basic laboratory techniques. (Total tuition time: ± 152 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/Module 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)

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 (MAT171T) **1 X 3-HOUR PAPER**

(Subject custodian: Department of Mathematics and Statistics)

Basic mathematics. Differentiation. Integration. Matrices. (Total tuition time: ± 90 hours)

MATHEMATICS II (MAT271T) **1 X 3-HOUR PAPER**

(Subject/Module custodian: Department of Mathematics and Statistics)

Differentiation: logarithmic differentiation, implicit functions, the inverse 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: ± 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: ± 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: ± 112 hours)

PHYSICS IA (PHU161B) **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: ± 90 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: ± 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)