

# BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY

(Qualification type: Professional Bachelor's Degree)

BSc (Industrial Chemistry) - NQF Level 8 (480 credits)

Qualification code: BPIY20

SAQA ID: 111429, CHE NUMBER: H/H16/E114CAN

Campus where offered:

Arcadia Campus

## REMARKS

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

• **APPLICANTS WHO OBTAINED A SENIOR CERTIFICATE BEFORE 2008:**

**Admission requirement(s):**

A Senior Certificate with a matriculation endorsement or an equivalent qualification, with a C symbol at Higher Grade or a B symbol at Standard Grade for English, Mathematics, and Physical Science.

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

**Admission requirement(s):**

A National Senior Certificate or an equivalent qualification, with a bachelor's degree endorsement, or an equivalent qualification, with an achievement level of at least 4 for English (home language or first additional language), 5 for Mathematics and 5 for Physical Sciences.

**Selection criteria:**

To be considered for this qualification, candidates must have an Admission Point Score (APS) of at least **24** (excluding Life Orientation).

b. *Assessment procedure(s):*

No further assessment will be done. Applicants who achieve the minimum APS will be considered until the programme complement is full. All completed applications received within the published due dates will be ranked. After consideration of the Departmental Student Enrolment Plan, only the top ranking applicants will be selected. Once a programme is full, a waiting list will be in place to provide an opportunity for applicants to fill places of those who did not register on time. Applicants will be informed of their status per official letter from the Office of the Registrar, alternatively, they can check their application status on the TUT website, [www.tut.ac.za](http://www.tut.ac.za).

c. *Recognition of Prior Learning (RPL), equivalence and status:*

See Chapter 30 of Students' Rules and Regulations.

d. *Intake for the qualification:*

January only.

e. *Presentation:*

Day classes.

f. *Minimum duration:*

Four years.

g. *Exclusion and readmission:*

See Chapter 2 of Students' Rules and Regulations.



*h. Re-registration:*

A student may re-register for the module Industrial Chemistry Project only with the permission of the Head of the Department. The purpose of the re-registration is to provide students with an opportunity to complete the project only, and not to redo it, should they fail the module.

## CURRICULUM

### FIRST YEAR

CODE	MODULE	NQF-L	CREDIT	PREREQUISITE MODULE(S)
ALI125X	Academic Literacy (block module)	(5)	(2)	
CHM105X	Chemistry I	(5)	(24)	
COE105X	Communication for Academic Purpose	(5)	(10)	
CPL105X	Computer Literacy	(5)	(10)	
LFS125X	Life Skills (block module)	(5)	(2)	
MAT105X	Mathematics I	(5)	(24)	
PHI105X	Physics I	(5)	(24)	
TOTAL CREDITS FOR THE FIRST YEAR:			<b>96</b>	

### SECOND YEAR

CODE	MODULE	NQF-L	CREDIT	PREREQUISITE MODULE(S)
MAT206P	Mathematics II	(6)	(24)	Mathematics I

#### FIRST SEMESTER

CAL216P	Chemical Process Industries II	(6)	(18)	Chemistry I
INA216X	Inorganic Chemistry IIA	(6)	(12)	Chemistry I
OCA216X	Organic Chemistry IIA	(6)	(12)	Chemistry I
PCA216X	Physical Chemistry IIA	(6)	(12)	Chemistry I Mathematics I

#### SECOND SEMESTER

INB216X	Inorganic Chemistry IIB	(6)	(18)	Inorganic Chemistry IIA
OCB216X	Organic Chemistry IIB	(6)	(18)	Organic Chemistry IIA
PCB216X	Physical Chemistry IIB	(6)	(18)	Physical Chemistry IIA

TOTAL CREDITS FOR THE SECOND YEAR: **132**

### THIRD YEAR

CODE	MODULE	NQF-L	CREDIT	PREREQUISITE MODULE(S)
ESY307P	Environmental Science and Technology III	(7)	(24)	Inorganic Chemistry IIA Organic Chemistry IIA Physical Chemistry IIA

#### FIRST SEMESTER

ISY317P	Industrial Synthesis III	(7)	(18)	Chemical Process Industries II Inorganic Chemistry IIA Mathematics II Organic Chemistry IIA Physical Chemistry IIA
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MSA317P	Material Science IIIA	(7)	(12)	Inorganic Chemistry IIA Mathematics II
PCH317P	Physical Chemistry III	(7)	(12)	Organic Chemistry IIA Physical Chemistry IIA Mathematics II
SRS317P	Separation Science III	(7)	(18)	Physical Chemistry IIB Inorganic Chemistry IIB Mathematics II Organic Chemistry IIB Physical Chemistry IIB

## SECOND SEMESTER

MSB317P	Material Science IIIB	(7)	(12)	Material Science IIIA
MSP317P	Molecular Spectroscopy III	(7)	(18)	Inorganic Chemistry IIB Mathematics II Organic Chemistry IIB Physical Chemistry IIB
PCL317P	Process Control III	(7)	(18)	Inorganic Chemistry IIB Mathematics II Organic Chemistry IIB Physical Chemistry IIB

TOTAL CREDITS FOR THE THIRD YEAR: **132**

## FOURTH YEAR

CODE	MODULE	NQF-L	CREDIT	PREREQUISITE MODULE(S)
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### FIRST SEMESTER

ISY418P	Industrial Synthesis IV	(8)	(18)	Industrial Synthesis III
MSP418P	Molecular Spectroscopy IV	(8)	(18)	Molecular Spectroscopy III
PCH418P	Physical Chemistry IV	(8)	(12)	Physical Chemistry III
RIY418P	Research Methodology IV (after completion of all first-, second and third-year modules)	(8)	(12)	

TOTAL CREDITS FOR THE SEMESTER: 60

### SECOND SEMESTER

ICC418P	Industrial Chemistry Practice IV (after completion of all first-, second and third-year modules)	(8)	(30)	
ICR418P	Industrial Chemistry Project IV	(8)	(30)	Industrial Synthesis IV Material Science IIIB Molecular Spectroscopy IV Physical Chemistry IV Research Methodology IV
ICR418R	Industrial Chemistry Project IV (re-registration) (first-semester module, see paragraph h)	(8)	(0)	

TOTAL CREDITS FOR THE SEMESTER: 60

TOTAL CREDITS FOR THE FOURTH YEAR: **120**

TOTAL CREDITS FOR THE QUALIFICATION: **480**

## 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 module. At time of publication, the syllabus content was defined as follows:

### A

#### **ACADEMIC LITERACY (ALI125X)**

**CONTINUOUS ASSESSMENT**

*(Module custodian: Directorate of Library and Information Services)*

Introduction of information literacy. Development of a search strategy and application of a search string to search engines and academic databases. Evaluation of information sources. Ethical and legal use of information. (Total notional time: 20 hours)

### C

#### **CHEMICAL PROCESS INDUSTRIES II (CAL216P)**

**1 X 3-HOUR PAPER**

*(Module custodian: Department of Chemical, Metallurgical and Materials Engineering)*

Introduction to chemical process industries; Petroleum refining; Pulp and paper manufacturing; Mineral Processing; Bulk manufacturing of ammonia and hydrogen; Bulk manufacturing of nitric acid, carbon dioxide and sulphuric acid; Air separation technologies: oxygen and nitrogen; Coal and coal processing; and Renewable energy technologies. (Total notional time: 180 hours)

#### **CHEMISTRY I (CHM105X)**

**1 X 3-HOUR PAPER**

*(Module custodian: Department of Chemistry)*

The role and importance of chemistry in everyday life. Classification and properties of matter. Units of measurement. Atoms, molecules and ions. The modern view of atomic structure and the use of electron configurations in chemical bonding. The periodic table of elements. The use of IUPAC rules for naming inorganic compounds. Application of the mole concept in stoichiometric calculations. Reactions in aqueous solutions. Chemical equilibrium. Fundamental concepts in electrochemistry. Organic nomenclature. (Total notional time: 240 hours)

#### **COMMUNICATION FOR ACADEMIC PURPOSE (COE105X)**

**1 X 3-HOUR PAPER**

*(Module custodian: Office of the Executive Dean)*

A workable knowledge of English is an essential skill for any graduate who is required to conduct themselves successfully in a professional working environment. This module will equip students with the competencies required to compose a selection of written texts related to communicating both internally and externally within a professional environment. In addition, the module includes strategies that are essential for the effective communication in various situations, including small groups to avoid unproductive conflict, a multicultural context, etc. (Total notional time: 100 hours)

#### **COMPUTER LITERACY (CPL105X)**

**CONTINUOUS ASSESSMENT**

*(Module custodian: End User Computing Unit)*

This module provides students with foundational knowledge in computing fundamentals, essential digital skills in key applications based on MS Office Suite and network basics (i.e. MS Outlook and Internet). Online exams are mapped with End-User Computing: SAQA 49077 (61591) Core Element as well as Internet and Computing Core Certification (IC3). (Total notional time: 100 hours)

### E

#### **ENVIRONMENTAL SCIENCE AND TECHNOLOGY III (ESY307P)**

**1 X 3-HOUR PAPER**

*(Module custodian: Department of Chemistry)*

Introduction to environmental science; Aquatic Chemistry; Geochemistry; Atmospheric Chemistry; Water Treatment; Toxicological Chemistry; and Industrial Ecology. (Total notional time: 240 hours)



**INDUSTRIAL CHEMISTRY PRACTICE IV (ICC418P)****WORK-INTEGRATED LEARNING****(Module custodian: Department of Chemistry)**

The module is designed to prepare students to function effectively in a working environment, which may include the following industries: petroleum and petrochemicals, pharmaceutical, pulp and paper, food processing, sugar and starch, dyestuffs, cement, paint and coating, fermentation, agrichemicals, mining and ore processing, water and sewage treatment. (Total notional time: 300 hours)

**INDUSTRIAL CHEMISTRY PROJECT IV (ICR418P/R)****PROJECT ASSESSMENT****(Module custodian: Department of Chemistry)**

The purpose of this module is to apply the knowledge of industrial synthesis, physical chemistry, organic chemistry, inorganic chemistry, separation science, molecular spectroscopy, process control, catalysis, material science and environmental science and technology in developing suitable methods and procedures for synthetic, production, characterisation, structural determination, transformation using both qualitative and quantitative techniques to propose and design innovative solutions to industrial process chemistry and laboratory problems. (Total notional time: 300 hours)

**INDUSTRIAL SYNTHESIS III (ISY317P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Electron absorption spectroscopy of various transition metal complexes; Industrial extraction, purification, properties and the chemistry of the platinum group metals; Biological and chemical catalysts; Biocatalysis; Preparation, treatment, characterisation and applications of heterogeneous catalysts. (Total notional time: 180 hours)

**INDUSTRIAL SYNTHESIS IV (ISY418P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Properties and reactions of chiral organic synthesis; Metals and metalloids-mediated organic synthesis; Biosynthetic pathways of natural products; Synthetic methods of medicinal chemistry and drug design; Preparation, treatment, characterisation and applications of homogeneous catalysts. (Total notional time: 180 hours)

**INORGANIC CHEMISTRY IIA (INA216X)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Covalent, ionic and metallic bonding; Inorganic thermodynamics; Solvent systems and acid-base behaviour and redox chemistry; Hydrogen and some of its compounds; Alkali metals and their compounds; Alkaline earth metals and their compounds; Boron and aluminium and their compounds; Carbon and silicon and their compounds; Nitrogen, phosphorous and their compounds; Oxygen, sulfur and their compounds; The Halogens and their compounds. (Total notional time: 120 hours)

**INORGANIC CHEMISTRY IIB (INB216X)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Bonding and the structure of molecules; Coordination Chemistry; Crystal field theory; Descriptive chemistry of d-block elements; Descriptive chemistry of the first transition metal series; Descriptive chemistry of Cu, Ag, Au and some of their compounds; Descriptive chemistry of Zn, Cd, Hg and some of their compounds. (Total notional time: 180 hours)

**LIFE SKILLS (LFS125X)****CONTINUOUS ASSESSMENT****(Module custodian: Directorate of Student Development and Support)**

Personal, socio-emotional and academic skills development for students in higher education. This module includes 1. Intra- and interpersonal skills (e.g. emotional intelligence, relationships, and conflict management); 2. General study skills (e.g. time management, goal setting, learning styles); 3. Health and wellness (e.g. HIV/AIDS, GBV issues, substance abuse); 4. Student life and adjustment (e.g. identity development, adjusting to a higher education environment); and 5. Financial management. (Total notional time: 20 hours)



**M**

**MATERIAL SCIENCE IIIA (MSA317P)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Fundamental concepts and structure of materials; Structure of crystalline and amorphous solids; Imperfections, failure, dislocations and strengthening mechanisms in materials. (Total notional time: 120 hours)

**MATERIAL SCIENCE IIIB (MSB317P)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Phase diagrams, phase transformation in metals and thermal processing of metal alloys; Ceramics: structure, properties, processing and applications; Polymer structures and composites. (Total notional time: 120 hours)

**MATHEMATICS I (MAT105X)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Mathematics and Statistics)

Consolidation of existing knowledge of and introduction to new types of functions; solution of systems of equations using matrices; introduction to vector algebra and complex numbers; application of differentiation and integration to solve well-defined problems. (Total notional time: 240 hours)

**MATHEMATICS II (MAT206P)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Mathematics and Statistics)

Series expansions; Applications of differentiation; Partial differentiation; Integration techniques; Applications of integration; and first-order ordinary differential equations (ODE's). (Total notional time: 240 hours)

**MOLECULAR SPECTROSCOPY III (MSP317P)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Introduction to Molecular Spectroscopy; Ultra-violet/Visible Spectroscopy; Infrared Spectroscopy; Mass spectroscopy; Nuclear Magnetic Resonance Spectroscopy. (Total notional time: 180 hours)

**MOLECULAR SPECTROSCOPY IV (MSP418P)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Principles of Molecular Spectroscopy and Powder Diffraction; Interpretation of Spectra; Spectral Analysis of Organic and Polymer Molecules; Spectral Analysis of Inorganic Compounds and Minerals; and Industrial and Environmental Applications. (Total notional time: 180 hours)

**O**

**ORGANIC CHEMISTRY IIA (OCA216X)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Nature of organic compounds; Structure and reactivity of: alkanes and cycloalkanes; alkenes and alkynes; Aromatic Chemistry; Stereochemistry; Properties and reactions of: alkyl halides; alcohols; ethers and epoxides; ketones and aldehydes; carboxylic acids; carboxylic acid derivatives; amines. (Total notional time: 120 hours)

**ORGANIC CHEMISTRY IIB (OCB216X)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Electrophilic and nucleophilic aromatic substitution reactions for the syntheses of benzene; Properties and reactions of carbonyl compounds for the syntheses of simple and complex carbonyl derivatives; Stereoisomerism in organic chemistry, Structure and properties of biomolecules; Carbohydrates, proteins, lipids and terpenes. (Total notional time: 180 hours)

**P**

**PHYSICAL CHEMISTRY IIA (PCA216X)** **1 X 3-HOUR PAPER**  
(Module custodian: Department of Chemistry)

Properties of gases, liquids, solids and solutions (such as pressure, temperature, composition, density, boiling points, viscosity, surface tension, concentration, vapour pressure and colligative properties). Basic thermodynamics properties (such as internal energy, enthalpy, heat capacity, entropy and Gibbs free energy), and equilibrium process (reaction and phase equilibrium). Fundamental electrochemical properties and processes such as electrode potentials, emf, electrolysis and corrosion). (Total notional time: 120 hours)



**PHYSICAL CHEMISTRY IIB (PCB216X)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Chemical Thermodynamics; Phase Changes; Electrochemistry; Chemical Kinetics; Quantum Chemistry; and Surface Chemistry. (Total notional time: 180 hours)

**PHYSICAL CHEMISTRY III (PCH317P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Surface Chemistry: physical and chemical behaviour of surfaces including interfaces such the solid-gas interface, liquid interface; Electrochemistry: electrical properties of interfaces, liquid interface, polarised and non-polarised electrode surfaces and their applications. (Total notional time: 120 hours)

**PHYSICAL CHEMISTRY IV (PCH418P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Statistical Thermodynamics: thermodynamic properties of macroscopic systems from microscopic constituents; energy, entropy and temperature per average atom; statistical postulates of quantum mechanics; molecular interpretation to describe heat capacity, entropy, internal energy, Gibbs free energy; Kinetics of complex reactions: reactions approaching equilibrium; the Arrhenius equation; Lindemann-Hinshelwood mechanism; the RRK (Rice-Ramsperger-Kassel) model; the Rice-Herzfeld mechanism; catalysis. (Total notional time: 120 hours)

**PHYSICS I (PHI105X)****1 X 3-HOUR PAPER****(Module custodian: Department of Physics)**

Basic Mathematical Concepts for Physics and measurements. Kinematics in one dimension. Kinematics in a plane (projectile motion). Forces and Newton's Laws of Motion. Momentum and Impulse. Work, Energy and Power. Rotational Kinematics. Rotational Dynamics. Elasticity. Static and dynamic fluids. Temperature and 0th Law of Thermodynamics. Thermal Expansion and Thermal Stress. First Law of Thermodynamics. Heat transfer. Gas Laws. General properties of waves. Reflection. Refraction. Interference and Diffraction of waves. Electrostatics. Electric Potential Energy and Potential Difference. Electric Circuits. (Total notional time: 240 hours)

**PROCESS CONTROL III (PCL317P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemical, Metallurgical and Materials Engineering)**

Introduction to process control; Control incentives and strategies; Controller principles and Control modes; Process instrumentation; and application and analysis of process instrumentation. (Total notional time: 180 hours)

**R****RESEARCH METHODOLOGY IV (RIY418P)****CONTINUOUS ASSESSMENT****(Module custodian: Department of Chemistry)**

Purpose, nature and meaning of research; Structure of a research proposal: identify a research problem; literature review; research aims, objectives and hypotheses; research design types; sampling procedures; validating results; research budget; referencing styles; Types of quantitative data; Basic principles of non-parametric tests: introduction to descriptive statistics; Probability (p-values) and hypothesis testing, introduction to inferential statistics (student's t-test, ANOVA and correlations); Interpretation of graphs and tables; Basic principles of research ethics; Dissemination of research findings. (Total notional time: 120 hours)

**S****SEPARATION SCIENCE III (SRS317P)****1 X 3-HOUR PAPER****(Module custodian: Department of Chemistry)**

Fundamentals of separation processes; Separation by phase addition or creation; Separation by barriers and solid agents; Separations that involve solid phase; and Extractions. (Total notional time: 180 hours)

