Students' Handbook

Chemical Engineering (Petroleum Refining and Petrochemical option)

Faculty of Engineering, Akpakip Oro University (AOU)

Academic year: [to be inserted]

Draft for Faculty approval

1. Welcome

Welcome to the Department of Chemical Engineering. This handbook explains the Chemical Engineering (Petroleum Refining and Petrochemical option) programme: what you will study, how you will be assessed, and where to get help. Read it alongside the university's academic regulations, which take precedence where they differ.

2. About the Programme

The programme trains chemical engineers who design, operate and improve the plants that turn raw materials into fuels, chemicals and materials. Years 1 and 2 build foundations in chemistry, mathematics, mechanics and thermodynamics. Years 3 to 5 add the option specialisation, culminating in an integrated plant design project and defence.

Graduate profile

- Apply chemistry and engineering principles to process design and operation.
- Design and analyse process equipment and plants to safe and applicable standards.
- Manage process safety, environmental impact and risk.
- Optimise plant performance and product quality.
- Work ethically and communicate effectively in teams.

Career pathways

Graduates may work in refineries, petrochemical and gas plants, fertilizer and polymer manufacturers, process engineering consultancies, equipment suppliers, and regulatory and environmental agencies. Graduates who register with COREN may practise as professional engineers in Nigeria. Postgraduate study is also an option.

Professional registration

Registration with the Council for the Regulation of Engineering in Nigeria (COREN) requires an accredited qualification and professional experience. Keep your SIWES records and project reports, as they support your later registration.

3. Programme Structure

The tables list every course, its units, the semester in which it is taken, and its track. Codes and units are provisional until confirmed in the approved CCMAS schedule.

Track: 'Core' is taken by all students. 'PR' marks Petroleum Refining courses and 'PT' marks Petrochemical courses. Both are within the Petroleum Refining and Petrochemical option.

Year 1: Engineering Foundations

Semester 1 (First semester)

Code	Course	Units	Track
CHE 101	Mathematics I	3	Core
CHE 102	General Physics I	3	Core
CHE 103	General Chemistry I	3	Core
CHE 104	Introductory Engineering	2	Core
CHE 105	Introduction to Computing	2	Core
CHE 106	Communication in English	2	Core
CHE 107	Engineering Laboratory Practicals	1	Core
CHE 108	Introduction to Chemical Engineering	2	Core

Code	Course	Units	Track
	Semester total	**18**	

Semester 2 (Second semester)

Code	Course	Units	Track
CHE 109	Mathematics II	3	Core
CHE 110	General Physics II	3	Core
CHE 111	General Chemistry II	2	Core
CHE 112	Engineering Drawing and Graphics	2	Core
CHE 113	Programming and Engineering Computation	2	Core
CHE 114	Nigerian Peoples and Cultures	2	Core
CHE 115	Chemistry Practicals	1	Core
CHE 116	Engineering Workshop and Safety	2	Core
	Semester total	**17**	

Year 2: Core Engineering

Semester 3 (First semester)

Code	Course	Units	Track
CHE 201	Organic Chemistry I	3	Core
CHE 202	Physical Chemistry I	3	Core
CHE 203	Engineering Mathematics	3	Core
CHE 204	Engineering Mechanics: Statics	2	Core
CHE 205	Material and Energy Balances	3	Core
CHE 206	Fluid Mechanics I	3	Core
CHE 207	Analytical Chemistry	2	Core
CHE 208	Engineering Materials	2	Core
	Semester total	**21**	

Semester 4 (Second semester)

Code	Course	Units	Track
CHE 209	Organic Chemistry II	3	Core
CHE 210	Physical Chemistry II	3	Core
CHE 211	Numerical Methods for Engineers	3	Core
CHE 212	Thermodynamics I	3	Core
CHE 213	Heat Transfer	3	Core
CHE 214	Fluid Mechanics II	3	Core
CHE 215	Chemical Engineering Laboratory I	2	Core
CHE 216	Process Instrumentation Fundamentals	2	Core
	Semester total	**22**	

Year 3: Specialist Foundations

Semester 5 (First semester)

Code	Course	Units	Track
CHE 301	Mass Transfer I	3	Core

Code	Course	Units	Track
CHE 302	Chemical Reaction Engineering I	3	Core
CHE 303	Thermodynamics II	3	Core
CHE 304	Process Dynamics and Control	3	Core
CHE 305	Unit Operations I (Separation)	3	Core
CHE 306	Process Equipment Design I	3	Core
CHE 307	Chemical Engineering Laboratory II	2	Core
CHE 308	Engineering Statistics and Research Methods	2	Core
	Semester total	**22**	

Semester 6 (Second semester)

Code	Course	Units	Track
CHE 309	Mass Transfer II	3	Core
CHE 310	Chemical Reaction Engineering II	3	Core
CHE 311	Unit Operations II	3	Core
CHE 312	Process Equipment Design II	3	Core
CHE 313	Petroleum Chemistry and Hydrocarbon Fundamentals	3	PR
CHE 314	Petroleum Refining Processes I	3	PR
CHE 315	Petrochemical Processes I	3	PT
CHE 316	Process Safety and Hazard Analysis	2	Core
	Semester total	**23**	

Year 4: Advanced Design and Industrial Practice

Semester 7 (First semester)

Code	Course	Units	Track
CHE 401	Petroleum Refining Processes II	3	PR
CHE 402	Catalysis and Catalytic Processes	3	Core
CHE 403	Petrochemical Processes II	3	PT
CHE 404	Polymer Science and Engineering	3	PT
CHE 405	Process Simulation and Design	3	Core
CHE 406	Plant Design and Economics	3	Core
CHE 407	Environmental Engineering	2	Core
CHE 408	Research Project I	2	Core
	Semester total	**22**	

Semester 8 (Second semester)

Code	Course	Units	Track
CHE 409	Petroleum Product Quality and Blending	3	PR
CHE 410	Petrochemical Process Analysis	3	PT
CHE 411	Gas Processing and Treatment	3	PR
CHE 412	Process Safety Engineering	3	Core
CHE 413	Industrial Process Control	3	Core
CHE 414	Corrosion and Materials in Process Plants	2	Core
CHE 415	Process Economics and Management	2	Core

Code	Course	Units	Track
CHE 416	Industrial Training (SIWES)	3	Core
	Semester total	**22**	

Year 5: Specialisation, Integration and Professional Readiness

Semester 9 (First semester)

Code	Course	Units	Track
CHE 501	Advanced Refinery Operations	3	PR
CHE 502	Advanced Petrochemical Technology	3	PT
CHE 503	Energy Policy and Regulation	2	Core
CHE 504	Process Optimisation	3	Core
CHE 505	Advanced Separation Processes	3	Core
CHE 506	Research Project II	3	Core
CHE 507	Bioprocess Engineering	2	Core
CHE 508	Technical Elective I	2	Core
	Semester total	**21**	

Semester 10 (Second semester)

Code	Course	Units	Track
CHE 509	Integrated Process Plant Design	3	Core
CHE 510	Refinery Plant Design	2	PR
CHE 511	Petrochemical Plant Design	2	PT
CHE 512	Environmental Impact and Sustainability	2	Core
CHE 513	Engineering Professional Practice and Ethics	2	Core
CHE 514	Risk Management in Process Industries	2	Core
CHE 515	Final-Year Design Project and Defence	4	Core
CHE 516	Technical Elective II	2	Core
	Semester total	**19**	

4. Course Specifications

Each entry gives the course description, learning outcomes, topics, assessment and recommended texts. Your lecturer issues the week-by-week scheme for each course.

Year 1: Engineering Foundations

CHE 101 Mathematics I

Units: 3 | Year 1, Semester 1 (First semester)

Description. Algebra, calculus and coordinate geometry for engineering.

Learning outcomes:

- Solve algebraic and trigonometric problems
- Apply differentiation to process rates

Course topics:

1. Functions and graphs
2. Differentiation
3. Integration
4. Applications

Assessment: CA 30 / Exam 70

Recommended texts: Stroud and Booth, Engineering Mathematics (latest edition)

CHE 102 General Physics I

Units: 3 | Year 1, Semester 1 (First semester)

Description. Mechanics, waves and thermal physics for engineers.

Learning outcomes:

- Analyse forces, motion and energy
- Apply conservation laws

Course topics:

1. Kinematics and dynamics
2. Work and energy
3. Rotation
4. Oscillations

Assessment: CA 30 / Exam 70

Recommended texts: Halliday, Resnick and Walker (latest edition)

CHE 103 General Chemistry I

Units: 3 | Year 1, Semester 1 (First semester)

Description. Atomic structure, bonding and stoichiometry.

Learning outcomes:

- Explain atomic structure and bonding
- Perform stoichiometric calculations

Course topics:

1. Atomic structure
2. Bonding
3. Stoichiometry
4. Solutions

Assessment: CA 30 / Exam 70

Recommended texts: Chang and Goldsby (latest edition)

CHE 104 Introductory Engineering

Units: 2 | Year 1, Semester 1 (First semester)

Description. Overview of engineering disciplines, problem solving and professional ethics.

Learning outcomes:

- Describe engineering disciplines
- Apply a structured problem-solving method

Course topics:

1. Disciplines and roles
2. Units
3. Problem solving
4. Professional ethics

Assessment: CA 50 / Exam 50

Recommended texts: Dym and Little (latest edition)

CHE 105 Introduction to Computing

Units: 2 | Year 1, Semester 1 (First semester)

Description. Computer fundamentals and productivity tools.

Learning outcomes:

- Use common computing tools
- Explain computer system components

Course topics:

1. Hardware
2. Operating systems
3. Productivity tools
4. Data management

Assessment: CA 60 / Exam 40

Recommended texts: Shelly and Vermaat (latest edition)

CHE 106 Communication in English

Units: 2 | Year 1, Semester 1 (First semester)

Description. Academic and technical writing and presentation.

Learning outcomes:

- Write clear technical reports
- Deliver structured presentations

Course topics:

1. Academic writing
2. Technical reports
3. Presentations
4. Listening

Assessment: CA 60 / Exam 40

Recommended texts: Swales and Feak (latest edition)

CHE 107 Engineering Laboratory Practicals

Units: 1 | Year 1, Semester 1 (First semester)

Description. Introductory measurement, error analysis and laboratory safety.

Learning outcomes:

- Record and analyse measurement data
- Apply laboratory safety procedures

Course topics:

1. Units and measurement
2. Error analysis
3. Data presentation
4. Laboratory safety

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

CHE 108 Introduction to Chemical Engineering

Units: 2 | Year 1, Semester 1 (First semester)

Description. Scope of chemical engineering across process, refining and petrochemical industries.

Learning outcomes:

- Describe chemical engineering roles
- Discuss process industries and careers

Course topics:

1. Process industries
2. Unit operations
3. Refining and petrochemicals
4. Professional bodies

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 109 Mathematics II

Units: 3 | Year 1, Semester 2 (Second semester)

Description. Matrices, series, vectors and differential equations.

Learning outcomes:

- Solve linear systems
- Solve first and second order differential equations

Course topics:

1. Matrices
2. Vectors
3. Series
4. Differential equations

Assessment: CA 30 / Exam 70

Recommended texts: Stroud and Booth (latest edition)

CHE 110 General Physics II

Units: 3 | Year 1, Semester 2 (Second semester)

Description. Electricity, magnetism, optics and modern physics.

Learning outcomes:

- Analyse electric and magnetic fields
- Apply optics and modern physics concepts

Course topics:

1. Electrostatics
2. Magnetism
3. Optics
4. Modern physics

Assessment: CA 30 / Exam 70

Recommended texts: Halliday, Resnick and Walker (latest edition)

CHE 111 General Chemistry II

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Thermochemistry, kinetics, equilibrium and electrochemistry.

Learning outcomes:

- Apply thermochemical and kinetic principles
- Explain chemical equilibrium

Course topics:

1. Thermochemistry
2. Kinetics
3. Equilibrium
4. Electrochemistry

Assessment: CA 30 / Exam 70

Recommended texts: Chang and Goldsby (latest edition)

CHE 112 Engineering Drawing and Graphics

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Orthographic projection and process drawing conventions.

Learning outcomes:

- Produce orthographic drawings
- Read process and piping symbols

Course topics:

1. Orthographic projection
2. Sections
3. Dimensioning
4. Process symbols

Assessment: Coursework 60 / Exam 40

Recommended texts: Giesecke et al., Technical Drawing (latest edition)

CHE 113 Programming and Engineering Computation

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Structured programming and numerical methods.

Learning outcomes:

- Write structured programs for engineering problems
- Apply numerical methods

Course topics:

1. Programming basics
2. Control structures
3. Functions
4. Numerical methods

Assessment: CA 50 / Exam 50

Recommended texts: Chapra (latest edition)

CHE 114 Nigerian Peoples and Cultures

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Nigerian history, cultures and national development, or applicable general studies as prescribed.

Learning outcomes:

- Describe Nigerian cultural diversity
- Discuss national development issues

Course topics:

1. Nigerian history
2. Cultural diversity
3. Governance
4. Contemporary issues

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 115 Chemistry Practicals

Units: 1 | Year 1, Semester 2 (Second semester)

Description. Laboratory experiments in general and analytical chemistry.

Learning outcomes:

- Perform standard chemistry experiments
- Write accurate laboratory reports

Course topics:

1. Titrations
2. Synthesis basics
3. Measurement
4. Report writing

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

CHE 116 Engineering Workshop and Safety

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Workshop practice and chemical and process plant safety.

Learning outcomes:

- Use common workshop tools safely
- Apply chemical plant safety standards

Course topics:

1. Workshop safety
2. Hand tools
3. Chemical safety
4. Plant safety

Assessment: Practical 70 / Exam 30

Recommended texts: Institutional workshop manual

Year 2: Core Engineering

CHE 201 Organic Chemistry I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Structure, reactions and mechanisms of organic compounds.

Learning outcomes:

- Explain organic structure and bonding
- Predict reaction mechanisms

Course topics:

1. Structure
2. Bonding
3. Reaction mechanisms
4. Functional groups

Assessment: CA 30 / Exam 70

Recommended texts: Solomons and Fryhle, Organic Chemistry (latest edition)

CHE 202 Physical Chemistry I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Chemical thermodynamics and phase equilibria.

Learning outcomes:

- Apply thermodynamic relations
- Analyse phase equilibria

Course topics:

1. Thermodynamic relations
2. Phase equilibria
3. Solutions
4. Chemical equilibrium

Assessment: CA 30 / Exam 70

Recommended texts: Atkins and de Paula, Physical Chemistry (latest edition)

CHE 203 Engineering Mathematics

Units: 3 | Year 2, Semester 3 (First semester)

Description. Partial derivatives, multiple integrals and Laplace transforms.

Learning outcomes:

- Apply Laplace transforms
- Solve partial differential problems

Course topics:

1. Partial derivatives
2. Multiple integrals
3. Laplace transforms
4. Fourier series

Assessment: CA 30 / Exam 70

Recommended texts: Kreyszig (latest edition)

CHE 204 Engineering Mechanics: Statics

Units: 2 | Year 2, Semester 3 (First semester)

Description. Force systems and equilibrium of process structures.

Learning outcomes:

- Analyse equilibrium of bodies
- Determine forces in supports

Course topics:

1. Force systems
2. Equilibrium
3. Friction
4. Centroids

Assessment: CA 30 / Exam 70

Recommended texts: Hibbeler (latest edition)

CHE 205 Material and Energy Balances

Units: 3 | Year 2, Semester 3 (First semester)

Description. Mass and energy balances on process systems.

Learning outcomes:

- Formulate material balances
- Formulate energy balances

Course topics:

1. Process units
2. Material balances
3. Energy balances
4. Recycle and bypass

Assessment: CA 30 / Exam 70

Recommended texts: Felder and Rousseau, Elementary Principles of Chemical Processes (latest edition)

CHE 206 Fluid Mechanics I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Fluid properties, hydrostatics and conservation principles.

Learning outcomes:

- Calculate hydrostatic forces
- Apply continuity and Bernoulli principles

Course topics:

1. Fluid properties
2. Hydrostatics
3. Continuity
4. Bernoulli equation

Assessment: CA 30 / Exam 70

Recommended texts: Streeter, Wylie and Bedford (latest edition)

CHE 207 Analytical Chemistry

Units: 2 | Year 2, Semester 3 (First semester)

Description. Quantitative analysis and instrumental methods.

Learning outcomes:

- Apply analytical quality control
- Use chromatographic methods

Course topics:

1. Quality control
2. Titrimetry
3. Chromatography
4. Spectroscopy

Assessment: CA 40 / Exam 60

Recommended texts: Skoog et al., Fundamentals of Analytical Chemistry (latest edition)

CHE 208 Engineering Materials

Units: 2 | Year 2, Semester 3 (First semester)

Description. Materials of construction for process plant.

Learning outcomes:

- Select materials for process conditions
- Explain corrosion resistance basics

Course topics:

1. Metals
2. Polymers
3. Ceramics
4. Corrosion basics

Assessment: CA 40 / Exam 60

Recommended texts: Callister and Rethwisch (latest edition)

CHE 209 Organic Chemistry II

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Aromatic chemistry and industrial organic reactions.

Learning outcomes:

- Explain aromatic reactivity
- Analyse industrial organic reactions

Course topics:

1. Aromatic chemistry
2. Industrial reactions
3. Carbonyl chemistry
4. Polymer precursors

Assessment: CA 30 / Exam 70

Recommended texts: Solomons and Fryhle (latest edition)

CHE 210 Physical Chemistry II

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Chemical kinetics and surface phenomena.

Learning outcomes:

- Analyse reaction kinetics
- Explain surface and catalytic phenomena

Course topics:

1. Rate laws
2. Mechanisms
3. Adsorption
4. Catalysis

Assessment: CA 30 / Exam 70

Recommended texts: Atkins and de Paula (latest edition)

CHE 211 Numerical Methods for Engineers

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Numerical solution of engineering equations.

Learning outcomes:

- Apply numerical root finding and interpolation
- Solve ODEs numerically

Course topics:

1. Root finding
2. Interpolation
3. Numerical integration
4. ODE solvers

Assessment: CA 40 / Exam 60

Recommended texts: Chapra (latest edition)

CHE 212 Thermodynamics I

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Energy, work and heat and the first and second laws.

Learning outcomes:

- Apply the first law to open systems
- Apply the second law to processes

Course topics:

1. First law
2. Second law
3. Properties
4. Cycles

Assessment: CA 30 / Exam 70

Recommended texts: Smith, Van Ness and Abbott, Introduction to Chemical Engineering Thermodynamics (latest edition)

CHE 213 Heat Transfer

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Conduction, convection and heat exchanger design.

Learning outcomes:

- Calculate conduction and convection
- Size simple heat exchangers

Course topics:

1. Conduction
2. Convection
3. Radiation
4. Heat exchangers

Assessment: CA 30 / Exam 70

Recommended texts: Incropera et al. (latest edition)

CHE 214 Fluid Mechanics II

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Pipe flow, pumps and fluid transport.

Learning outcomes:

- Design pipe systems
- Select pumps

Course topics:

1. Pipe flow
2. Head losses
3. Pumps
4. Piping networks

Assessment: CA 30 / Exam 70

Recommended texts: Streeter, Wylie and Bedford (latest edition)

CHE 215 Chemical Engineering Laboratory I

Units: 2 | Year 2, Semester 4 (Second semester)

Description. Experiments in heat transfer, fluid flow and reaction kinetics.

Learning outcomes:

- Carry out process experiments
- Write technical lab reports

Course topics:

1. Heat transfer tests
2. Fluid flow tests
3. Kinetics tests
4. Reporting

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

CHE 216 Process Instrumentation Fundamentals

Units: 2 | Year 2, Semester 4 (Second semester)

Description. Sensors, transmitters and measurement in process plants.

Learning outcomes:

- Select process sensors
- Interpret instrument signals

Course topics:

1. Temperature
2. Pressure
3. Flow
4. Level

Assessment: CA 40 / Exam 60

Recommended texts: Liptak, Instrument Engineers' Handbook (latest edition)

Year 3: Specialist Foundations

CHE 301 Mass Transfer I

Units: 3 | Year 3, Semester 5 (First semester)

Description. Diffusion and mass transfer coefficients.

Learning outcomes:

- Calculate diffusion rates
- Apply mass transfer coefficients

Course topics:

1. Diffusion
2. Mass transfer coefficients
3. Gas absorption
4. Stage concepts

Assessment: CA 30 / Exam 70

Recommended texts: Geankoplis, Transport Processes and Separation Process Principles (latest edition)

CHE 302 Chemical Reaction Engineering I

Units: 3 | Year 3, Semester 5 (First semester)

Description. Reactor design for homogeneous reactions.

Learning outcomes:

- Design batch and continuous reactors
- Analyse conversion and yield

Course topics:

1. Reaction kinetics
2. Batch reactors
3. CSTR
4. PFR

Assessment: CA 30 / Exam 70

Recommended texts: Fogler, Elements of Chemical Reaction Engineering (latest edition)

CHE 303 Thermodynamics II

Units: 3 | Year 3, Semester 5 (First semester)

Description. Phase and chemical equilibrium for process design.

Learning outcomes:

- Apply phase equilibrium
- Apply chemical equilibrium

Course topics:

1. VLE
2. Equations of state
3. Chemical equilibrium
4. Activity

Assessment: CA 30 / Exam 70

Recommended texts: Smith, Van Ness and Abbott (latest edition)

CHE 304 Process Dynamics and Control

Units: 3 | Year 3, Semester 5 (First semester)

Description. Dynamic models and feedback control of process plant.

Learning outcomes:

- Model process dynamics
- Tune feedback controllers

Course topics:

1. Dynamic models
2. Transfer functions
3. PID control
4. Tuning

Assessment: CA 30 / Exam 70

Recommended texts: Seborg et al., Process Dynamics and Control (latest edition)

CHE 305 Unit Operations I (Separation)

Units: 3 | Year 3, Semester 5 (First semester)

Description. Distillation, absorption and extraction.

Learning outcomes:

- Design simple distillation columns
- Analyse absorption and extraction

Course topics:

1. Distillation
2. McCabe-Thiele
3. Absorption
4. Extraction

Assessment: CA 30 / Exam 70

Recommended texts: Seader and Henley, Separation Process Principles (latest edition)

CHE 306 Process Equipment Design I

Units: 3 | Year 3, Semester 5 (First semester)

Description. Design of vessels, columns and heat exchangers.

Learning outcomes:

- Design pressure vessels
- Specify process equipment

Course topics:

1. Pressure vessels
2. Columns
3. Heat exchangers
4. Codes

Assessment: CA 40 / Exam 60

Recommended texts: Towler and Sinnott, Chemical Engineering Design (latest edition)

CHE 307 Chemical Engineering Laboratory II

Units: 2 | Year 3, Semester 5 (First semester)

Description. Separation, reaction and process control experiments.

Learning outcomes:

- Carry out separation experiments
- Analyse experimental data

Course topics:

1. Distillation tests
2. Reactor tests
3. Control tests
4. Data analysis

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

CHE 308 Engineering Statistics and Research Methods

Units: 2 | Year 3, Semester 5 (First semester)

Description. Statistics and research design for engineering.

Learning outcomes:

- Apply descriptive and inferential statistics
- Design simple experiments

Course topics:

1. Descriptive statistics
2. Probability
3. Hypothesis testing
4. Research design

Assessment: CA 40 / Exam 60

Recommended texts: Montgomery and Runger (latest edition)

CHE 309 Mass Transfer II

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Packed columns, membrane and advanced separations.

Learning outcomes:

- Design packed columns
- Evaluate membrane separations

Course topics:

1. Packed columns
2. Membranes
3. Adsorption
4. Advanced separations

Assessment: CA 30 / Exam 70

Recommended texts: Geankoplis (latest edition)

CHE 310 Chemical Reaction Engineering II

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Non-ideal reactors and heterogeneous catalysis.

Learning outcomes:

- Analyse non-ideal reactors
- Design catalytic reactors

Course topics:

1. Residence time distribution
2. Non-ideal flow
3. Catalytic reactors
4. Heterogeneous kinetics

Assessment: CA 30 / Exam 70

Recommended texts: Fogler (latest edition)

CHE 311 Unit Operations II

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Crystallisation, drying and solids processing.

Learning outcomes:

- Design crystallisers and dryers
- Analyse solids handling

Course topics:

1. Crystallisation
2. Drying
3. Solids handling
4. Filtration

Assessment: CA 30 / Exam 70

Recommended texts: Seader and Henley (latest edition)

CHE 312 Process Equipment Design II

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Design of reactors, pumps and process machinery.

Learning outcomes:

- Design process reactors
- Select process machinery

Course topics:

1. Reactor design
2. Pumps and compressors
3. Agitation
4. Materials selection

Assessment: CA 30 / Exam 70

Recommended texts: Towler and Sinnott (latest edition)

CHE 313 Petroleum Chemistry and Hydrocarbon Fundamentals

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Composition, classification and properties of crude oil and hydrocarbons.

Learning outcomes:

- Classify crude oil fractions
- Explain hydrocarbon properties

Course topics:

1. Crude composition
2. Hydrocarbon families
3. Properties
4. Assays

Assessment: CA 30 / Exam 70

Recommended texts: Speight, The Chemistry and Technology of Petroleum (latest edition)

CHE 314 Petroleum Refining Processes I

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Crude distillation and primary refining processes.

Learning outcomes:

- Explain crude distillation
- Analyse primary refining units

Course topics:

1. Atmospheric distillation
2. Vacuum distillation
3. Desalting
4. Primary units

Assessment: CA 30 / Exam 70

Recommended texts: Gary, Handwerk and Kaiser, Petroleum Refining (latest edition)

CHE 315 Petrochemical Processes I

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Feedstocks and steam cracking for olefins.

Learning outcomes:

- Describe petrochemical feedstocks
- Analyse steam cracking

Course topics:

1. Feedstocks
2. Steam cracking
3. Olefin production
4. Aromatics

Assessment: CA 30 / Exam 70

Recommended texts: Meyers, Handbook of Petroleum Refining Processes (latest edition)

CHE 316 Process Safety and Hazard Analysis

Units: 2 | Year 3, Semester 6 (Second semester)

Description. Hazard identification and risk analysis for process plants.

Learning outcomes:

- Apply hazard identification methods
- Conduct process risk analysis

Course topics:

1. HAZOP
2. What-if analysis
3. Risk matrices
4. Safeguards

Assessment: CA 40 / Exam 60

Recommended texts: CCPS, Guidelines for Hazard Evaluation Procedures (latest edition)

Year 4: Advanced Design and Industrial Practice

CHE 401 Petroleum Refining Processes II

Units: 3 | Year 4, Semester 7 (First semester)

Description. Conversion, treatment and blending processes in refining.

Learning outcomes:

- Explain catalytic cracking and reforming
- Analyse hydrotreating

Course topics:

1. Catalytic cracking
2. Reforming
3. Hydrotreating
4. Alkylation

Assessment: CA 30 / Exam 70

Recommended texts: Gary, Handwerk and Kaiser (latest edition)

CHE 402 Catalysis and Catalytic Processes

Units: 3 | Year 4, Semester 7 (First semester)

Description. Catalyst types, deactivation and catalytic process design.

Learning outcomes:

- Select catalysts
- Analyse deactivation

Course topics:

1. Catalyst types
2. Adsorption
3. Deactivation
4. Catalyst design

Assessment: CA 30 / Exam 70

Recommended texts: Fogler (latest edition)

CHE 403 Petrochemical Processes II

Units: 3 | Year 4, Semester 7 (First semester)

Description. Downstream petrochemicals and their processes.

Learning outcomes:

- Describe downstream petrochemical routes
- Analyse process economics

Course topics:

1. Ethylene derivatives
2. Propylene
3. Aromatics
4. Process economics

Assessment: CA 30 / Exam 70

Recommended texts: Meyers (latest edition)

CHE 404 Polymer Science and Engineering

Units: 3 | Year 4, Semester 7 (First semester)

Description. Polymer synthesis, structure and processing.

Learning outcomes:

- Explain polymerisation routes
- Relate structure to properties

Course topics:

1. Polymerisation
2. Molecular weight
3. Polymer structure
4. Processing

Assessment: CA 30 / Exam 70

Recommended texts: Fried, Polymer Science and Technology (latest edition)

CHE 405 Process Simulation and Design

Units: 3 | Year 4, Semester 7 (First semester)

Description. Steady-state process simulation and flowsheet design.

Learning outcomes:

- Build steady-state process simulations
- Evaluate flowsheet options

Course topics:

1. Simulation
2. Flowsheets
3. Sensitivity
4. Design evaluation

Assessment: Coursework 60 / Exam 40

Recommended texts: Departmental reading list, to be confirmed

CHE 406 Plant Design and Economics

Units: 3 | Year 4, Semester 7 (First semester)

Description. Process flowsheet design and cost estimation.

Learning outcomes:

- Prepare process flowsheets
- Estimate capital and operating costs

Course topics:

1. Flowsheets
2. Capital costs
3. Operating costs
4. Profitability

Assessment: Design project 60 / Exam 40

Recommended texts: Towler and Sinnott (latest edition)

CHE 407 Environmental Engineering

Units: 2 | Year 4, Semester 7 (First semester)

Description. Air, water and waste management in process industries.

Learning outcomes:

- Assess emissions and effluents
- Describe treatment options

Course topics:

1. Emissions
2. Effluent treatment
3. Waste management
4. Regulations

Assessment: CA 40 / Exam 60

Recommended texts: Davis and Cornwell (latest edition)

CHE 408 Research Project I

Units: 2 | Year 4, Semester 7 (First semester)

Description. Literature review and proposal for the final-year project.

Learning outcomes:

- Conduct a literature review
- Write a research proposal

Course topics:

1. Literature search
2. Research questions
3. Methodology
4. Proposal writing

Assessment: Proposal 100

Recommended texts: Supervisor guidance and departmental guide

CHE 409 Petroleum Product Quality and Blending

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Specifications, testing and blending of refined products.

Learning outcomes:

- Test product quality
- Design blends to specification

Course topics:

1. Product specifications
2. Quality tests
3. Blending
4. Additives

Assessment: CA 30 / Exam 70

Recommended texts: Departmental reading list, to be confirmed

CHE 410 Petrochemical Process Analysis

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Analysis of petrochemical process performance.

Learning outcomes:

- Analyse petrochemical process performance
- Identify improvement options

Course topics:

1. Performance analysis
2. Yield
3. Energy use
4. Improvement

Assessment: CA 30 / Exam 70

Recommended texts: Meyers (latest edition)

CHE 411 Gas Processing and Treatment

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Natural gas treatment, dehydration and sweetening.

Learning outcomes:

- Design gas treatment steps
- Analyse dehydration and sweetening

Course topics:

1. Gas composition
2. Sweetening
3. Dehydration
4. Gas processing

Assessment: CA 30 / Exam 70

Recommended texts: Mokhatab et al., Handbook of Natural Gas Transmission and Processing (latest edition)

CHE 412 Process Safety Engineering

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Process safety management and inherently safer design.

Learning outcomes:

- Apply process safety management
- Specify safety instrumented systems

Course topics:

1. Process safety management
2. Inherent safety
3. Relief systems
4. Safety instrumented systems

Assessment: CA 30 / Exam 70

Recommended texts: CCPS (latest edition)

CHE 413 Industrial Process Control

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Advanced control strategies for industrial processes.

Learning outcomes:

- Design cascade and ratio control
- Apply advanced control methods

Course topics:

1. Cascade control
2. Ratio control
3. Feedforward
4. Model predictive control basics

Assessment: CA 30 / Exam 70

Recommended texts: Seborg et al. (latest edition)

CHE 414 Corrosion and Materials in Process Plants

Units: 2 | Year 4, Semester 8 (Second semester)

Description. Corrosion and materials selection for plant equipment.

Learning outcomes:

- Select materials against corrosion
- Specify corrosion control

Course topics:

1. Corrosion mechanisms
2. Materials selection
3. Inspection
4. Protection

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 415 Process Economics and Management

Units: 2 | Year 4, Semester 8 (Second semester)

Description. Economic and management tools for process industries.

Learning outcomes:

- Estimate process economics
- Apply project management tools

Course topics:

1. Cost estimation
2. Profitability
3. Scheduling
4. Management

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 416 Industrial Training (SIWES)

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Supervised industrial attachment in a relevant organisation.

Learning outcomes:

- Apply engineering knowledge in practice
- Keep a professional logbook

Course topics:

1. Workplace induction
2. Practical tasks
3. Reporting
4. Professional conduct

Assessment: Logbook 40 / Report 40 / Assessor 20

Recommended texts: SIWES guidelines issued by the Industrial Training Fund and AOU

Year 5: Specialisation, Integration and Professional Readiness

CHE 501 Advanced Refinery Operations

Units: 3 | Year 5, Semester 9 (First semester)

Description. Operation, optimisation and troubleshooting of refineries.

Learning outcomes:

- Analyse refinery operations
- Troubleshoot refinery units

Course topics:

1. Operations
2. Optimisation
3. Troubleshooting
4. Turnarounds

Assessment: CA 30 / Exam 70

Recommended texts: Departmental reading list, to be confirmed

CHE 502 Advanced Petrochemical Technology

Units: 3 | Year 5, Semester 9 (First semester)

Description. Advanced petrochemical process technology and integration.

Learning outcomes:

- Evaluate petrochemical technology options
- Integrate petrochemical processes

Course topics:

1. Technology options
2. Integration
3. Energy integration
4. Scale-up

Assessment: CA 30 / Exam 70

Recommended texts: Meyers (latest edition)

CHE 503 Energy Policy and Regulation

Units: 2 | Year 5, Semester 9 (First semester)

Description. Energy policy, regulation and market structure.

Learning outcomes:

- Evaluate energy policy
- Describe regulatory requirements

Course topics:

1. Policy instruments
2. Regulation
3. Markets
4. Compliance

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 504 Process Optimisation

Units: 3 | Year 5, Semester 9 (First semester)

Description. Optimisation methods for process design and operation.

Learning outcomes:

- Formulate optimisation problems
- Apply optimisation methods

Course topics:

1. Linear programming
2. Nonlinear optimisation
3. Constraints
4. Case studies

Assessment: CA 30 / Exam 70

Recommended texts: Edgar, Himmelblau and Lasdon, Optimization of Chemical Processes (latest edition)

CHE 505 Advanced Separation Processes

Units: 3 | Year 5, Semester 9 (First semester)

Description. Advanced separation technologies for process plants.

Learning outcomes:

- Evaluate advanced separation technologies
- Select separation options

Course topics:

1. Membranes
2. Supercritical extraction
3. Adsorption
4. Selection

Assessment: CA 30 / Exam 70

Recommended texts: Seader and Henley (latest edition)

CHE 506 Research Project II

Units: 3 | Year 5, Semester 9 (First semester)

Description. Execution, analysis and reporting of the final-year project.

Learning outcomes:

- Execute a research project
- Report findings professionally

Course topics:

1. Data collection
2. Analysis
3. Writing
4. Oral presentation

Assessment: Project 100

Recommended texts: Supervisor guidance and departmental guide

CHE 507 Bioprocess Engineering

Units: 2 | Year 5, Semester 9 (First semester)

Description. Bioreactors and bioprocess operations.

Learning outcomes:

- Describe bioreactor operation
- Analyse bioprocess yields

Course topics:

1. Bioreactors
2. Fermentation
3. Downstream processing
4. Yields

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 508 Technical Elective I

Units: 2 | Year 5, Semester 9 (First semester)

Description. Elective from the approved chemical engineering list.

Learning outcomes:

- Apply specialist knowledge in the chosen area
- Evaluate case studies

Course topics:

1. Selected topic
2. Case studies
3. Applications
4. Review

Assessment: CA 40 / Exam 60

Recommended texts: As specified for the chosen elective

CHE 509 Integrated Process Plant Design

Units: 3 | Year 5, Semester 10 (Second semester)

Description. Capstone design of an integrated process plant.

Learning outcomes:

- Integrate process units into a plant design
- Produce a coordinated design

Course topics:

1. Plant integration
2. Design documentation
3. Safety
4. Review

Assessment: Design project 100

Recommended texts: Departmental design brief

CHE 510 Refinery Plant Design

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Design of refinery units and their integration.

Learning outcomes:

- Design refinery units
- Evaluate refinery configurations

Course topics:

1. Unit design
2. Configurations
3. Integration
4. Economics

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 511 Petrochemical Plant Design

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Design of petrochemical plants and their utilities.

Learning outcomes:

- Design petrochemical units
- Specify plant utilities

Course topics:

1. Unit design
2. Utilities
3. Layout
4. Economics

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 512 Environmental Impact and Sustainability

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Environmental assessment of process industries.

Learning outcomes:

- Assess environmental impacts
- Apply sustainability criteria

Course topics:

1. Impact assessment
2. Carbon accounting
3. Waste minimisation
4. Sustainability criteria

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 513 Engineering Professional Practice and Ethics

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Professional conduct, registration and engineering law.

Learning outcomes:

- Apply professional ethics
- Describe registration and legal responsibilities

Course topics:

1. Ethics
2. Professional bodies
3. Registration
4. Engineering law

Assessment: CA 50 / Exam 50

Recommended texts: Departmental reading list, to be confirmed

CHE 514 Risk Management in Process Industries

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Risk assessment and management for process operations.

Learning outcomes:

- Conduct risk assessments
- Develop risk management plans

Course topics:

1. Risk assessment
2. Risk criteria
3. Management plans
4. Monitoring

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

CHE 515 Final-Year Design Project and Defence

Units: 4 | Year 5, Semester 10 (Second semester)

Description. Culminating integrated design project with defence.

Learning outcomes:

- Produce a complete design project
- Defend design decisions orally

Course topics:

1. Design development
2. Documentation
3. Presentation
4. Defence

Assessment: Project 60 / Defence 40

Recommended texts: Departmental project guide

CHE 516 Technical Elective II

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Second elective from the approved chemical engineering list.

Learning outcomes:

- Apply specialist knowledge in the chosen area
- Evaluate case studies

Course topics:

1. Selected topic
2. Case studies
3. Applications
4. Review

Assessment: CA 40 / Exam 60

Recommended texts: As specified for the chosen elective

5. Industrial Training (SIWES)

- SIWES is taken in Year 4, Semester 8, for 3 units.
- Keep a daily or weekly logbook that records tasks, supervision and what you learned.
- Obtain the placement letter and supervisor details before you start.
- Your final report and assessor's evaluation are part of your assessment.
- Follow the Industrial Training Fund and AOU SIWES guidelines throughout.

6. Assessment and Academic Regulations

Assessment follows the university's approved academic regulations, which govern grading, attendance, progression, carry-over and classification. This summary does not replace those regulations.

- Continuous assessment (CA) is set by course. Examinations form the remainder unless a course states otherwise.
- Practical and laboratory courses are assessed on reports, practical work and, where stated, a viva.
- Design projects and the final-year defence are assessed by a panel using published rubrics.
- Report any missed assessment through the department as soon as possible, with supporting evidence.
- Grading and classification are as set out in the regulations: [insert AOU grading table].

7. Student Support and Conduct

- **Academic advising:** each student is assigned an adviser. Meet your adviser at least once a semester.
- **Academic integrity:** plagiarism, falsified data and unauthorised collaboration are serious offences.
- **Respect and inclusion:** treat staff, colleagues and communities with dignity; report harassment through the appropriate channel.
- **Wellbeing:** seek help early from your adviser or the university welfare services.

8. Laboratory, Workshop and Field Safety

- Wear the prescribed personal protective equipment (PPE) in laboratories, workshops and on sites.
- Follow the instructions of the technician and lecturer. Never operate equipment you have not been trained to use.
- Report every accident, near miss and damaged equipment immediately.
- Hydrocarbons and reactive chemicals are flammable or toxic: handle them under the data sheet and fume-extraction rules.
- Pressurised equipment can cause serious injury: never open pressurised lines without the prescribed isolation.
- Refinery and plant visits follow the site's permit-to-work, hard-hat and gas-detection rules.
- Report all spills, leaks and near misses immediately, and use the emergency response plan for your laboratory.

9. Contacts

Role	Name	Contact
Head of Department	[to be inserted]	[to be inserted]
Programme coordinator	[to be inserted]	[to be inserted]
Level advisers	[to be inserted]	[to be inserted]
SIWES coordinator	[to be inserted]	[to be inserted]
Laboratory technical officer	[to be inserted]	[to be inserted]