



RHODES UNIVERSITY

Where leaders learn

CHEMISTRY 2

COURSE OUTLINE

Chem 2 Class Rep:

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Course Coordinator

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Chemistry 2 is divided into two semester courses:

CHE201 – lectured from February to June and examined in June by two 3-hour exams and

CHE202 – lectured from July to October and examined in November by three 2-hour exams.

Normally a student will register for both courses at the beginning of the year, but one course may be taken alone. Each week there are 5 lectures, 4½ practical hours and one tutorial. Practical and theory tests and tutorial assignments may be set.

MINIMUM ENTRY REQUIREMENT:

To register for either **CHE201** or **CHE202**, credits for both **CHE101** and **CHE102** or an aggregated credit (ACR) for CHEMISTRY 1 are required. Recommended that student also take **MAT 1C** (both semesters) so that they can cope with the **Physical Chemistry** demands in CHE2.

MID-SEMESTER DEPARTMENTAL TESTS:

These will be in the same format as the end-of-semester examination. The marks for these tests will be included in the final mark as detailed below. They will be held at 7 pm on **25th March, 2020 (Venue Chemistry Major/Minor)** and **02nd September, 2020 (Venue TBA)**.

EXAMINATIONS:

FINAL MARK: for each semester course comprises:

60% from the combined marks for the two theory papers,

10% from the mark for the mid-semester Departmental test

10% from the class tests mark (Module Tests and Assignments)

20% from the marks for the relevant practical courses as follows:

CHE201 – 10% from the analytical practical marks

– 10% from the marks for the analytical project.

CHE202 – 10% from the organic practical marks

– 10% from the physical practical marks

MODULE TEST: Module tests should be no more than 45 min (1 period)

MID SEMESTER TEST: Mid semester test should be no more than 2 hours.

CREDITS:

To obtain a credit in either course the overall mark for that course must be **AT LEAST 50%** with **AT LEAST 40%** in the combined **THEORY** papers.

An aggregated credit (ACR) will be awarded for CHEMISTRY 2 if the total combined marks for CHE201 and CHE202 are **AT LEAST 50%** with **AT LEAST 40%** required as subminimum for both **CHE201 THEORY** and **CHE202 THEORY** and **45%** of the overall for the course.

NOTE: Aggregation is only permitted for semester courses written in the same calendar year.

There are **NO** supplementary examinations for either CHE201 or CHE202.

DULY PERFORMED CERTIFICATES (Rule G19 in the University Calendar):

A DP certificate is required before a student is permitted to write a course examination. To obtain a DP certificate for either CHE201 or CHE202 examinations a student must have attended **AT LEAST** 80% of all lectures and performed all assigned tutorials, essays and practical work satisfactorily. Absences must be communicated *in writing* and the Leave of Absence form submitted. There is **NO** supplementary examination for Chem 2.

TEXTBOOKS:

- (i) D.A. Skoog, D.M. West and F.J. Holler, *Fundamentals of Analytical Chemistry*, 9th Ed. (or earlier), Saunders College.
- (ii) G. D. Christian, *Analytical Chemistry*, 6th Ed (earlier), WILEY
- (iii) Douglas, B., McDaniel, D., Alexander, J., *Concepts and Models of Inorganic Chemistry*, 3rd Ed., Wiley.
- (iv) Atkins, P.W. *Physical Chemistry*, 9th Ed, Oxford (recommended).
- (v) D.F. Shriver, P.W. Atkins, C.H. Langford, *Inorganic Chemistry*, 2nd Ed., Oxford (supplementary)
- (vi) P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, *Inorganic Chemistry*, 4th Ed., Oxford (supplementary)
- (vii) T. W. G. Solomons, C. B. Fryhle, and S. A. Snyder, *Organic Chemistry*, 11th Ed., Wiley
- (viii) J. McMurry, *Organic Chemistry: A Biological Approach*, 2nd Ed. (or earlier editions)

LECTURES: (Periods 2-3-4-5-1)

Lectures start on **Monday 10th February, 2020** in **Arts Minor** at **8:40 am** (2nd period).

PRACTICALS:

Semester 1: Thursdays (**13:30 – 18:00**) commencing on the **13th February, 2020**.

Semester 2: Thursdays (**13:30 – 18:00**) commencing on the **16th July, 2020**.

Attendance to ALL the practicals is compulsory. If for whatever the reason/s you are granted an LOA, you will be required to submit the practical write-up. Please discuss with the Practical Coordinator preferably before the practical. You have to attend **AT LEAST** 80% of the practicals offered each semester.

Practical reports not handed in by the due date will score 0 marks.

A non-refundable fee of **R280** per semester is charged to cover accidental breakage of equipment, laboratory notes, lecture handouts and other course materials.

TIMETABLE – CHEMISTRY 201 – 2020

	DATES	TOPIC	LECTURER	NO OF LECTURES
CHE201	10/2 – 21/2	Statistics, and classical methods	MSK	10
	24/2 – 05/3	Sampling and sample handling	VS	09
Test	06/3 – 25/3	Spect. methods (UV, IR, FES, AAS, ICP)	VS	14
Wednesday	26/3 – 20/4	Introduction to chromatography	VS	07
25 th March	21/4 – 07/5	NMR and MS	KL	11
	08/5 – 22/5	Electroanalytical	PNM	11

TIMETABLE – CHEMISTRY 202 – 2019

	DATES	TOPIC	LECTURER	NO OF LECTURES
CHE202 Test Wednesday 02nd September	13/7 – 24/7	Chemical kinetics	PNM	10
	27/7 – 07/8	Thermodynamics	MSK	11
	11/8 – 14/9	Inorganic chemistry principles	SH	19
	14/9 – 01/10	Fossil fuels and organic chem.	RK	13
	02/10 – 09/10	Aromatics	RuiK	6
	12/10 – 16/10	Polymers (Natural/Synthetic)	RuiK	5

Key to lecturers:

Initials	Name	Room no.
PNM	Dr P. N. Mashazi	F44
RK	Prof R. Klein	F38
KL	Prof K. Lobb	S40
MSK	Prof M. S. Khene	S39
VS	Dr V. Smith	S35
RuiK	Prof R. W. M. Krause	F42
SH	Mr Siya Hulushe	F12 (Laboratory)

CHE201

Lectured from February to June. Examined in June by two 3-hour exams (Paper A and Paper B). Contents of the papers are as follows (refer to timetable for number of lectures).

CHE 201 MID-SEMESTER TEST (WEDNESDAY – 25th MARCH 2020)

(Venue – Chem Major or Minor)

CHEMISTRY 201: 1½ hours

Answer 3Q out of 3 in 90 minutes. 20 marks in 30 min. Total Marks = 60

Question no.	Topic	Lecturer	Marks
1	Statistics, and classical methods	Prof M. S. Khene	20
2	Sampling and Sample Handling	Dr V. Smith	20
3	Spect. methods (UV, IR, FES, AAS, ICP)	Dr V. Smith	20

PAPER A

ANALYTICAL METHODS

Sampling and sample handling

Introduction to aspects about sampling, especially for complex samples. Sample clean-up, sample pre-concentration or sample enrichment. Challenges associated with analysing a standard sample as compared to real samples. Strategies employed for analytes in solid, liquid and gaseous matrices.

Statistics, and classical methods

Statistical treatment of random errors. Application of statistics to data treatment and evaluation. Classical quantitative analysis.

Spectroscopic methods

Origins of spectra, electromagnetic radiation, interaction of radiation with matter, Beer's Law. Equipment for molecular absorption and emission, single and double beam. Origins of UV/vis spectra, selection rules. Origins of IR spectra, dispersive and Fourier transform spectrometers, samples and cells. Principles of atomic absorption and emission spectroscopies, equipment, flames, furnaces, plasmas, interferences.

PAPER B

ANALYTICAL METHODS contd.

Introduction to chromatography

Introduction. Plate theory and HETP. Physical ideas behind plate theory. GLC and HPLC: instrumentation, detectors, columns; qualitative and quantitative analysis.

Electroanalytical techniques

Review of 1st year Electrochemistry. Applications of electrode potentials. The electrochemical cell, potentials in a cell, ohmic and concentration polarisation. Polarography. Voltammetry, linear and cyclic, sensors, microelectrodes. Stripping voltammetry. Coulometric methods of analysis.

Nuclear magnetic resonance (NMR) spectroscopy and mass spectrometry (MS)

Introduction to NMR and physical principles; FT-NMR; chemical shifts, interpreting ¹H and ¹³C NMR spectra; using ¹H and ¹³C NMR spectroscopies to determine structure of organic molecules.

Introduction to MS; physical principles behind electron impact (EI) mass spectrometry, equipment and interpretation; fragmentation, including α -cleavage and McLafferty rearrangements of ketones.

SUMMARY OF CHEMISTRY 201 EXAMINATION PAPERS

Answer ALL questions (100 marks) in 3 hours. 1Q = 20 marks in 36 mins

CHEM 201 Paper A:

Question no.	Topic	Lecturer	Mark
1, 2 (10)	Sampling and sample handling	Dr V. Smith	30
2 (10), 3	Statistics, and classical methods	Prof M. S. Khene	30
4, 5	Spectroscopic Methods	Dr V. Smith	40

CHEM 201 Paper B

Question no.	Topic	Lecturer	Mark
1, 2	NMR and MS	Prof K. Lobb	40
3, 4	Electroanalytical Techniques	Dr P. N. Mashazi	40
5	Intro to Chromatography	Dr V. Smith	20

CHE202

Lectured from July to November. Examined in November by two 3-hour exams (Paper A and Paper B). Contents of the papers are as follows (refer to timetable for number of lectures).

CHE 202 MID-SEMESTER TEST (WEDNESDAY – 02 September 2020)

(Venue – TBA)

CHEMISTRY 202: 1½ hours

Answer 2Q out of 2 in 90 minutes. 30 marks in 45 min. Total Marks = 60

Question no.	Topic	Lecturer	Marks
1	Inorganic Chem	Mr S. Hulushe	20
2	Kinetics	Dr P. N. Mashazi	20
3	Thermodynamics	Prof M. S. Khene	20

PAPER A

STRATEGIC ORGANIC RESOURCES

Fossil fuels and organic chemicals

Sources of organic chemicals: coal, petroleum, synthesis gas and primary refinery processes.

Alkenes and alkynes: applications and reactions as chemical feedstocks.

Cycloalkanes: structure, stereochemistry and synthesis.

Aromatic Chemistry

Benzenoid aromatics: electrophilic substitution, reactions and orientation effects; nucleophilic substitution mechanisms; diazonium salts.

Heterocycles: structure and reactivity of basic systems.

POLYMER CHEMISTRY

Organic polymers:

Natural polymers: rubber, carbohydrates, proteins, DNA – structure and properties.

Synthetic polymers: preparative methods, synthesis, recycling.

PAPER B

Thermodynamics

Internal energy, heat and work, enthalpy, heat capacities. The first law of thermodynamics. Reversible and irreversible processes. Thermochemistry. Entropy. The second and third laws of thermodynamics. The Gibbs function.

Chemical Kinetics

Rate equations for complex reactions; the Arrhenius equation; the activation energy and the pre-exponential factor; the activated complex; molecularity and reaction mechanisms; complex reactions; consecutive reactions; the steady state approximation; enzyme kinetics.

PAPER C

Descriptive Inorganic Chemistry and Chemical Principles

Periodic trends of the main group elements: Periodicity, chemical properties related to atomic size and electron configuration. Electronegativity and hard and soft acid and base theories, and some applications. General properties of the main group elements.

Representative main group chemistry: a more in-depth focus on specific elements.

Introduction to the transition elements: periodic trends and the general properties related to electronic structure.

SUMMARY OF CHEMISTRY 202 EXAMINATION PAPERS

Answer ALL questions (80 marks) in 2 hours. 1Q = 20 marks in 30 mins

CHEM 202 Paper A

Question no.	Topic	Lecturer	Marks
1, 2	Fossil Fuels and Organic Chemicals	Prof R. Klein	40
3, 4	Aromatics and Polymers	Prof R. W. M. Krause	40

CHEM 202 Paper B

Question no.	Topic	Lecturer	Marks
1, 2	Chemical Kinetics	Dr P. N. Mashazi	40
3, 4	Thermodynamics	Prof M. S. Khene	40

CHEM 202 Paper C

Question no.	Topic	Lecturer	Marks
1, 2, 3, 4	Inorganic Chem	Mr S. Hulushe	80