Geology 278
Gemmology and Mineralogy

2nd Semester

1. GENERAL INFORMATION

Lecturer:	Dr. Jodie Miller,
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Consultation:	In theory I am available anytime but in practice I may be otherwise occupied. My preference would be for you to email me and arrange a time.

Course Description:	Geology 278 is a full year course carrying 32 credits
Class Timetable:	Tues 2nd period 9.00am – 9.50am (L) Wed 4th period 11.00am – 11.50am (L) Fri 5th period 12.00 – 12.50pm (L) Mon practical 2.00pm – 5.00pm Thur practical 9.00am – 12.00 pm

2. COURSE OVERVIEW

The use of the petrographic microscope is essential for geologists as it is the most cost effective way of identifying minerals and thus classifying rocks. This course in optical mineralogy is specifically designed to enable the learner to identify minerals based on their optical properties. This knowledge is immediately applied to identifying minerals present in igneous and metamorphic rocks and to classifying these rocks. Introductory concepts in petrographic interpretation of mineral assemblages and textures are discussed and their use in identifying igneous and metamorphic rocks explored.

3. COURSE OUTCOMES

Students should have the following skills at the end of the course.

- Practical ability to use mineral optical properties to identify the common rock forming minerals in thin sections.
- Understanding of the petrological classification of igneous and metamorphic rocks from mineral proportion and mineral textural information.
- Competence in practical igneous and metamorphic rock description.
- Understanding of simple igneous systems, including the use of binary and ternary phase diagrams in interpreting igneous rock petrogenesis.
- Understanding of simple metamorphic systems including the use of the phase rule and the concept of equilibrium
- Practical ability to classify rocks using established geochemical classification systems.

These skills will form the fundamental background to advanced petrogenetic and petrographic concepts developed in third year modules.

4. COURSE ASSESSMENT

4.1 Progress and Class Mark

The progress mark for second semester is composed of: (1) continuous assessment of marked practical work, (2) tests during the semester, and (3) a practical test at mid-semester.

The marked practical work is composed of 10 practical assignments. One of these is a take home assignment. The practicals are worth 40% of the progress mark (i.e. each practical is worth 4%). Due dates for practicals are clearly indicated on the practical when it is handed out in class.

Four 40 minute theory tests will be held during the semester. The dates are given below. An optional fifth test will be scheduled according to student's timetables. The four best marks are combined to give a single test mark out of 20 (i.e. each test is worth 5%).

The practical test will be 2 hours in duration and will require microscope identification of minerals and hand specimen examination. This test is worth 40% of the second semester progress mark.

Therefore the progress mark for second semester is calculated as follows:

Practical work	40%
Test mark (best of 4)	20%
Practical test	40%

At the end of second semester, the progress mark for assessment criteria set in the second semester, will be combined in a ratio 50:50 with the progress mark from the first semester to give a class mark for the year. To qualify for the final theory exam (on the material presented in second semester only), all students must obtain a class mark of 40% or more for the whole year.

4.2 Practical Exam

All students sit a practical exam on the second semester material in the last week of the second semester. This exam will require students to identify minerals in a thin-section using skills that they have developed during the semester, to write a description of the thin-section and to make some simply geological interpretations about the thin-section. This mark is combined with the practical exam mark from the first semester in a ratio 50:50. Students must obtain a sub-minimum of 50% average mark in order to pass the GEOL278 course.

In the event that any student does not obtain an average of 50% for the combined practical exam mark, a second chance practical exam will be provided on material from both semesters prior to the date of the final theory exam subject to consultation with the relevant students.

4.3 Final Exam

To sit the final theory exam all students must obtain a sub-minimum of 50% average mark in the practical exams for the year as well as a class mark of 40% or more for the combined mark for both semesters The final exam in November is a 3 hour theory exam covering all aspects of the course material given in the second semester. Entrance to the final examination in November requires a year class mark of at least 40%. Note that as a result of changes to the examination procedure there is no second option exam available. All students sitting the G278 course **must** sit the first exam in November. Students who for medical reasons are unable to sit the first exam, will be allowed to sit the second exam which follows directly after the first in late November. A medical certificate must be provided. In addition the student will be required to complete an official declaration on a specified form to declare that he/she had indeed been ill.

The first exam period is from the 29th November. The second exam period is in December.

	JUNE and NOVEMBER FIRST EXAMINATION		JUNE and NOVEMBER SECOND EXAMINATION	
	Student	**Consequence**	**Student**	**Consequence**
First semester **or** second semester **or** year module (Admission to the examination requires a class mark of at least 40)	1. Writes, obtaining a final mark of 50 or more	Passes the module	—	—
	2. Writes, obtaining a final mark of 40 or 45	Allowed to rewrite in second examination (*automatic* admission)	Writes, obtaining a final mark of 50 or more	Passes the module
			Writes, obtaining a final mark of less than 50	Fails the module, must repeat it next year
			Absent, for whatever reason(s)	Fails the module, must repeat it next year
	3. Writes, obtaining a final mark of less than 40	Fails the module, must repeat it next year	—	—
	4. Absent due to illness, proven by a medical certificate and declaration	Allowed, with permission of the Examinations Office, to write the second examination	Writes, obtaining a final mark of 50 or more	Passes the module
			Writes, obtaining a final mark of less than 50	Fails the module, must repeat it next year
			Absent, for whatever reason(s)	Fails the module, must repeat it next year
	5.Absent	Fails the module, must repeat it next year		

Further guidelines to changes in the examination procedure are available in Part 1 of the University Calendar 2007.

4.4 Compilation of the final semester mark

The final performance mark for the year will consist of the final class mark and the final exam mark in a ratio 40:60 respectively. The final class mark is calculated as above while the final exam mark for the year is made up of the average mark for the two practical exams and the average mark of the two theory exams in the ratio 25:75 respectively**.**

Provided that the examination mark is 50% or more, the performance mark will not be less than 50%. Final marks between 35 and 50 will be allocated in multiples of 5 at the department's discretion and in line with university policy.

If a student obtains a final mark of 45 or 40, he/she will be allowed to sit the second exam which will follow directly after the first in November or early December.

A final mark of less than 50 shall be allocated is a student obtains a final exam mark of less than 40. A final mark of less than 40 shall be allocated if a student obtains an examination mark of less than 30.
See the above table for details.

4.5 Exam and Test Dates

Students are advised to take note of the following exam dates:

- 6th September – First Practical Exam
- 18th October – Second Practical Exam
- 21st November 7.00pm – First Theory Examination

- 6th December 7.00pm – Second Theory Examination (as required)

Note that the official test date of 5th October will NOT be used.

Theory test dates during the semester are as follows:

- 10th August
- 7th September
- 28th September
- 12th October

The fifth test date will be set in consultation with the students. The best four marks from the above 40 minute tests will be combined into the class mark as described above in section 4.1.

5. SUGGESTED TEXT AND REFERENCE BOOKS

It is strongly recommended that students taking the G278 course in the second semester purchase a copy of the following reference book.

Introduction to the Rock-Forming Minerals by Deer, Howie and Zussman, Longman Scientific and Technical

This book is a reference book and will be suitable for use through to the end of your degree and further depending on your career path. This book can be purchased from Protea Bookstores and a group order can be placed if insufficient copies are available in stock.

Other reference and text book that will be of use include

Introduction to Mineralogy by William D Nesse, Oxford University Press
Petrology: The study of igneous, metamorphic and sedimentary rocks by Loren A Raymond
An Introduction to Metamorphic Petrology by Bruce W.D. Yardley, Longman Earth Science Series

These books will be available on reserve at the library. It is not necessary for you to buy copies of these books.

6. PRACTICAL AND CLASS CONDUCT

- This course is a practical course that involves the use of the optical microscope and thin-sections. Please make every effort to look after material provided to you in the course.
- Access to the practical room is available to all registered students at any time provided that this does not clash with other classes. After hours access can be arranged through George (Rm 1036).
- Continued after hours access to the practical room is subject to satisfactory behaviour in the practical room.
- Cell phones must be switched off during lectures.
- Students should bring to the attention of the lecturer, any reason whether illness or otherwise, why they were unable to attend classes or complete set work. In the event of illness, a medical certificate must be provided giving satisfactory information as to why the absence was necessary. This is essential for missed practical work. In the absence of a satisfactory explanation for missing practical work, a mark of zero (0) will be applied.

7. PROBLEMS

- Students should feel free to discuss any problem concerning their progress in the course or their progress mark with the lecturer.
- Problems concerning the class as a whole should first be directed to the class representative who will discuss the issue on behalf of the class with the lecturer.
- If agreement cannot be reached the lecturer will ask another staff member to adjudicate.

8. ADVICE ON PRACTICAL ASSIGNMENTS

- Always read through your answer
- Make sure you answer the question being asked
- Label your diagrams carefully, including a scale
- Use different shades of grey or patterns to indicate different minerals
- Pay particular attention to grain boundary relationships as these can tell you a lot about processes.

9. WEB-BASED RESOURCES

The following websites have useful compilations on optical mineralogy

***** http://www.uwgb.edu/dutchs/petrolgy/thinsect.htm
This whole site is very good!
***** http://www.hmag.gla.ac.uk/John/taching/mintable.htm
Also very good site with excellent summary tables

These sites are also useful and have similar information but just on optical mineralogy
http://www.brocku.ca/earthsciences/people/gfinn/optical/222lect.htm
http://webmineral.com/
http://www.gly.bris.ac.uk/www/teach/opmin/mins.html

8. LECTURE AND PRACTICAL TIMETABLE

WEEK	DATE	DAY	PROGRAM
JULY			
1	24th	Tues	Lecture 1 – Introduction and course overview
	25th	Wed	Lecture 2 – Introduction to Light
		Mon/Thur	*Practical 1 – No practical*
	27th	Fri	Lecture 3 – Refractometry and Relief
2	31st	Tues	Lecture 4 – Birefringence and Retardation
AUGUST			
	1st	Wed	Lecture 5 – Introduction to the Optical Microscope
		Mon/Thur	*Practical 2 – Introduction to Optical Identification of Minerals*
	3rd	Fri	Lecture 6 – Interference Colors
3	7th	Tues	Lecture 7 – Pleochroism and Extinction Angle
	8th	Wed	Lecture 8 – Extinction Angle
		Mon/Thur	*Practical 3 – Introduction to Optical Identification of Minerals*
August 9th Women's Day Holiday – Career's in Earth Sciences, GSSA 9:30 – 16:30 Stellenbosch			
	10th	Fri	**Test 1**
4	14th	Tues	Lecture 9 – The Optical Indicatrix
	15th	Wed	Lecture 10 – Interference Figures

		Mon/Thur	*Practical 4 – Relationship between Mineralogy and Geochemistry in the Identification of Rocks and Minerals*
	17th	Fri	Lecture 11 – Mineralogy of Rocks - Revision
5	21st	Tues	Lecture 12 –Geochemistry of Rocks
	22nd	Wed	Lecture 13 - Revision of Igneous Petrology and Rock Classification
		Mon/Thur	*Practical 5 – Revision of Igneous Petrology and Rock Classification*
	24th	Fri	Lecture 14 – Revision of Metamorphic Petrology and Rock Classification
6	28th	Tues	Lecture 15 – Mineral Associations
	29th	Wed	Lecture 16 – Mineral Textures
		Mon/Thur	*Practical 6 – Revision of Metamorphic Petrology and Rock Classification*
	31st	Fri	Lecture 17 - Layered Igneous Intrusions
SEPTEMBER			
7	4th	Tues	Lecture 18 – Introduction to the Bushveld Complex
	5th	Wed	Lecture 19 – Ocean Crust, Ophiolites and Alteration
		Mon/Thur	***Practical Test***
	7th	Fri	**Test 2**
MID-SEMESTER BREAK 19TH TO 14TH			
8	18th	Tues	Lecture 20 – Granites and granitic rocks
	19th	Wed	Lecture 21 – Feldspar compositions and textures and their signifcance
		Mon/Thur	*Practical 7 – Petrography of the Bushveld Complex*
	21st	Fri	Lecture 22 – Textures of Igneous Rocks in Thin-section
9	25th	Tues	Lecture 23 – Volcanoes and Volcanic Rocks
	26th	Wed	Lecture 24 – Volcanoes and Volcanic Rocks
		Mon/Thur	*Practical 8 – Mineralogy and Texture of Volcanic Lava Types*
	28th	Fri	**Test 3**
OCTOBER			
10	2nd	Tues	Lecture 25 – Introduction to Metamorphism
	3rd	Wed	Lecture 26 – Metamorphic Grade, Mineralogy and Textures
		Mon/Thur	*Practical 9 – Mineralogy of Metamorphic Rocks*
	5th	Fri	Lecture 27 – Progressive Metamorphism of Pelites
11	9th	Tues	Lecture 28 – Metamorphic Textures
	10th	Wed	Lecture 29 – Subduction zone metamorphism
		Mon/Thur	*Practical 10 – Mineralogy and Texture of Blueschists and Eclogites*
	12th	Fri	**Test 4**
12	16th	Tues	Lecture 30 – Mineralogy and Tectonics

	17th	Wed	Lecture 31 – Revision
		Mon/Thur	*Second Practical Exam – Braai in quad afterwards*
	19th	Fri	Last day of semester – No lecture

9. LECTURE SUMMARIES

Summaries for each lecture will be provided at the beginning of each lecture. Copies of the powerpoint lecture notes will be available on WebCT Vista and the relevant departmental website page after the lecture.

10. PRACTICAL SUMMARY

It is required that all practical work be submitted for marking. Each practical is due at the **end** of the practical except where practicals run for more than one practical session. Such practicals are clearly marked. Penalties will be applied for late submission of work in the following manner.

- Failure to submit before 5.10pm – 5%
- Failure to submit before 6.00pm – 10%
- Failure to submit before 9.00am subsequent day – 20%
- Failure to submit before the end of subsequent day – 100%

Any student who is unable to submit required work on time should consult with the lecturer as soon as possible so that alternate arrangements can be made. In the event that there are class problems with submission of material, the submission time may be changed through consultation with the lecturer and the class as a whole.

Practical Sessions

Practical One – Introduction to the Petrographic Microscope

- Introduction to using the petrographic microscope
- Care and identification of different parts of the microscope
- This practical has no assessment

Practical Two – Introduction to the Optical Identification of Minerals

- Learn how to identify minerals in thin section
- Understand the difference between birefringence, pleochroism, extinction angle, color and relief.
- Construct a table summarizing the main features of different rock-forming minerals to use as a tool for thin-section work.

Practical Three – Introduction to the Optical Identification of Minerals

- Continuation from practical two

Practical Four – Relationship between Mineralogy and Geochemistry in the Identification of Rocks and Minerals

- Understand the relationship between chemical composition of a rock and the modal mineralogy
- Understand how the modal mineralogy can be used to make inferences about tectonic environments
- Understand how the mineralogy can be used to make inferences about pressure and temperature

Practical Five - Revision of Igneous Petrology and Rock Classification

- Understand how the IUGS classification system works
- Understand the difference between classifications based on mineral mode and chemical composition
- Identify different igneous rocks based on their mineral mode
- Understand the difference in chemistry of different igneous rocks based on mineral mode

Practical Six – Revision of Metamorphic Petrology and Rock Classification

- Understand how metamorphic rocks are classified and how the naming system works
- Understand the difference between classifications based on mineral mode, chemical composition and texture
- Identify different metamorphic rocks based on their mineralogy and texture
- Understand the difference in chemistry of different metamorphic rocks based on mineral mode

Practical Seven - Petrography of the Bushveld Complex

- Investigate the mineralogy and texture of the different magma compositions making up the Bushveld Layered Igneous Complex
- Understand the basic processes leading to the formation of layered igneous intrusions
- Understand how to determine the composition of plagioclase from thin-sections

Practical Eight – Mineralogy and Texture of Volcanic Lava Types

- Investigate the mineralogy and texture of different lava compositions
- Compare the characteristics of different lava types
- Examine the changes that occur in thin-section in response to low temperature alteration of basalts

Practical Nine – Mineralogy of Metamorphic Rocks

- Compare and contrast the textures of high-grade rocks and low-grade rocks
- Compare and contrast the mineralogy of high-grade rocks and low-grade rocks
- Understand in a general way the processes responsible for any differences.

Practical Ten – Mineralogy and Texture of Blueschists and Eclogites

- Understand the concept of equilibration and the metastable character of many blueschists and eclogites
- Identify the mineralogy of blueschists and eclogites and understand how this differs from rocks formed in different environments
- Understand the geodynamic significance of subduction zones for the mineralogical development in subducted oceanic and sedimentary material