LSC Use Only Proposal No: LSC Action-Date:	*UWUCC Use Only* Proposal No: 14-97d UWUCC Action-Date: AP- 11/11/14 Senate Action Date: App - 12/2/14

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Karen Rose Cercone**	Email Address **kcercone@iup.edu**
Proposing Department/Unit **Geoscience**	Phone 724-357- **7650**

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

__X__ New Course _____ Course Prefix Change _____ Course Deletion

_____ Course Revision _____ Course Number and/or Title Change _____ Catalog Description Change

Current course prefix, number and full title: **GEOS 345 Igneous and Metamorphic Petrology**

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

_____ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

_____ Learning Skills _____ Knowledge Area _____ Global and Multicultural Awareness _____ Writing Intensive (include W cover sheet)

_____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

_____ Global Citizenship _____ Information Literacy _____ Oral Communication

_____ Quantitative Reasoning _____ Scientific Literacy _____ Technological Literacy

3. Other Designations, as appropriate

_____ Honors College Course _____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

_____ Catalog Description Change _____ Program Revision _____ Program Title Change _____ New Track

_____ New Degree Program _____ New Minor Program _____ Liberal Studies Requirement Changes _____ Other

Current program name:

Proposed program name, if changing:

5. Approvals	**Signature**	**Date**
Department Curriculum Committee Chair(s)	Kenneth S. Cole	3/31/2014
Department Chairperson(s)	Gen A. Va	4/24/14
College Curriculum Committee Chair	Jane Kado	10/17/14
College Dean	Deane Lang	10/20/14
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail Sechrist	11/11/14

Part II. Description of Curricular Change

1. SYLLABUS OF RECORD

I. Catalog Description

GEOS 345 Igneous and Metamorphic Petrology (3c-3l-4cr)
Prerequisite: Grade of C or better in GEOS 301
Introduces the origins of igneous and metamorphic rocks in the context of plate tectonic activity, emphasizing melting and crystallization processes as well as metamorphic reactions. Laboratory exercises focus on rock identification and interpretation in hand sample and petrographic microscopy. Includes field trips that may occur on weekends.

II. Course Objectives

At the end of this course, students will be able to:
1) Correlate common minerals with igneous and metamorphic rocks and use mineral associations to identify the temperature and pressure conditions and environment under which these rocks form.
2) Classify approximately fifty igneous and metamorphic rocks commonly encountered in geology and relate them to the tectonic setting in which they form.
3) Explain the relationship between rock chemistry, phase relations, and geologic occurrence.
4) Use the optical microscope to identify common igneous and metamorphic rocks in thin section on the basis of their mineralogy and textures.
5) Interpret rock textures and mineralogy to recreate emplacement history for igneous and metamorphic rocks and describe the sequence of tectonic events required to produce such textures.

III. Course Outline

Lecture Schedule

A. *Origin of the Solar System and Earth, composition and structure of the Earth* (3 hours)
B. *Classification of igneous rocks, magma generation and crystallization, igneous structures and field relationships* (4 hours)
C. *Phase diagrams: unary, binary, and ternary systems; crystallization sequences* (5 hours)
D. Exam 1 (1 hour)
E. *Diversification of magmas, partial melting, fractional crystallization, magma mixing* (4 hours)
F. *Mid-ocean ridge, subduction zone, and intraplate oceanic volcanism, flood basalts* (6 hours)
G. Exam 2 (1 hour)
H. *Granites- genesis, petrology and classification* (3 hours)
I. *Introduction to Metamorphism; environments, stresses, fluids and protoliths, facies and grades* (4 hours)
J. *Classification of Metamorphic Rocks; foliated and non-foliated, facies and grades, mafic vs pelitic* (5 hours)
K. *Structures and textures of metamorphic rocks; deformation, recovery and recrystallization, stable mineral assemblages, metasomatism* (6 hours)

L. Final exam (2 hours during final exam period)

Lab Schedule

Week 1	Introduction to igneous minerals and textural terms- review of optical microscopy
Week 2	Intrusive mafic and ultramafic rocks; ophiolite sequence
Week 3	Extrusive mafics; ocean island basalts and hot spot volcanism
Week 4	Intrusive felsic and intermediate igneous rocks; subduction zone volcanism
Week 5	Extrusive felsic and intermediate volcanic rocks; subduction zone volcanism
Week 6	Magma differentiation
Week 7	Unusual igneous rocks (kimberlite, komatiite, carbonatite)
Week 8	**Lab Exam 1**
Week 9	Introduction to metamorphic minerals and textural terms
Week 10	Metamorphic grade, index minerals and the Barrovian sequence (Pelites)
Week 11	Metamorphic facies; mafic mineral assemblages
Week 12	Metasomatism, ultramafic, calcareous and quartz-rich metamorphic rocks
Week 13	Metamorphic textures
Week 14	**Lab Exam 2**

IV. Evaluation Methods
The final class grade will be determined from the following assessments:

Lecture Exam 1	15 %
Lecture Exam 2	15 %
Final Lecture Exam	20 %
Lecture assignments	10 %
Lab assignments	20 %
Lab Exam 1	10 %
Lab Exam 2	10 %
Total	100 %

V. Example Grading Scale
The final grade will be assigned based on the semester average using the scale: 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D and below 60%=F.

VI. Attendance Policy
The attendance policy will conform to IUP's undergraduate course attendance policy.

VII. Required Textbook(s), Supplemental Books and Readings.
Winter, Principles of Igneous and Metamorphic Petrology, 2nd ed. (2009)
This is the most recent edition.

VIII. Special Resource Requirements.
Students must purchase a 10X hand lens for lab exercises. These typically run $5-20 depending on quality.

IX. Bibliography

The following resources will be used to develop the course curriculum:

Demange, Michel Andre (2012) Mineralogy for Petrologists: Optics, Chemistry, and Occurrences of Rock-forming Minerals. CRC Press, 218 pp.

Farndon, John (2013) The Complete Illustrated Guide To Rocks Of The World: A practical directory of over 150 igneous, sedimentary and metamorphic rocks: Lorenz, 128 pp.

Frost, B. Ronald, and Carol D. Frost (2013) Essentials of Igneous and Metamorphic Petrology. Cambridge University Press, 336 pp.

Gill, Robin (2011) Igneous Rocks and Processes: A Practical Guide. Wiley-Blackwell, 440 pp.

Haldar, S. K. (2013) Introduction to Mineralogy and Petrology. Elsevier, 305 pp.

Higgins, Michael Denis (2007) Quantitative Textural Measurements in Igneous and Metamorphic Petrology. Cambridge University Press, 276 pp.

Hirsch, D. M. (2013) The Educational Value Of Metamorphic Phase Diagrams: Transforming Student Thinking. Geological Society of America Abstracts with Programs v. 45, p. 10.

Jerram, Dougal and Nick Petford, (2011) The Field Description of Igneous Rocks (2nd Ed.) Wiley, 256 pp.

Klein, Cornelis, and Anthony Philpotts (2012) Earth materials: introduction to mineralogy and petrology. Cambridge University Press, 552 pp.

Maria, Anton. H., Evan Millam, and Carrie L. Wright (2011) Using a Differential Scanning Calorimeter to Teach Phase Equilibria to Students of Igneous and Metamorphic Petrology. Journal of Geoscience Education, v. 59, p. 63-70.

Philpotts, Anthony and Jay Ague (2009) Principles of Igneous and Metamorphic Petrology (2nd Ed), Cambridge University Press, 684 pp.

Reid, M. R. (2010) Rethinking how Undergraduate "Hard Rock" Petrology is Taught. AGU Fall Meeting Abstracts, v. 1, p. 0605.

Ryan, Jeffrey. G. (2014) Supporting the Transition from Geoscience Student to Researcher Through Classroom Investigations Using Remotely Operable Analytical Instruments Geoscience Research and Education: Springer-Verlag, pp. 149-162.

Shelley, D. (1992) Igneous and Metamorphic Rocks under the Microscope: Classification, textures, microstructures and mineral preferred orientation. Springer, 446 pp.

Winter, John (2009) Principles of Igneous and Metamorphic Petrology (2nd Ed). Prentice-Hall, 720 pp.

Course Analysis Questionnaire

Section A: Details of the Course

A1 This course is designed for junior and senior geology majors. It will be a track requirement for the B.S. in Geology / Geology Track; a track option for the B.S. in Geology / Environmental Track; and it can be used as a Controlled Elective for the B.S. in Geology / Energy Resources Track.

The material covered by this course was the subject of a stand-alone course, GEOS 322 Igneous and Metamorphic Petrology, from 1968 until 2008. During our last curriculum update, the department experimented with combining Mineralogy and Petrology into a single-semester course in an attempt to reduce the number of required classes and improve 4-year graduation rates. While other parts of the 2008-2009 curriculum reform were successful, faculty analysis of student learning outcomes during our department planning retreats has consistently identified rock and mineral identification and interpretation as a weak area for recent geoscience graduates. Analysis of the current curriculum pointed to the merger of Mineralogy and Petrology as a major factor in this unsatisfactory outcome.

In order to close the loop in our assessment process, we want to return to a two-course sequence: GEOS 301 Mineralogy (the topic of an associated course revision) and GEOS 345 Igneous and Metamorphic Petrology (the topic of this new course proposal). A new course proposal is required because the old course GEOS 322 has been deleted from the curriculum; we are taking the opportunity to change the course number at this time to conform to our current system of numbering upper-level majors classes. The new course number is available per the Registrar's master list.

A2 The split of petrology from mineralogy requires that we also revise GEOS 301 Mineralogy as part of this same package. We plan to implement these course changes in conjunction with a program revision of all three B.S. in geology tracks that reduces non-geology requirements for all tracks and maintains flexibility in course scheduling through the use of optional choices for program requirements and a broad slate of controlled electives. No courses or programs outside the department will be impacted by these changes to upper-level geology major courses.

A3 This course was offered for several decades at IUP as GEOS 322 Igneous and Memtamorphic Petrology. We are simply resurrecting it and giving it a new course number.

A4 This will not be a dual-level course.

A5 This will not be a variable credit course.

A6 Most undergraduate geology programs in the United States offer an upper-level undergraduate course similar to this. There are numerous examples of recent offerings, including:

Ashland University: GEOL 312 Igneous and Metamorphic Petrology
Brock University: ERSC 3P21 Igneous and Metamorphic Petrology
California State at Northridge: GEOL 307 Igneous and Metamorphic Petrology
California University of Pennsylvania: EAS 322 Petrology
Franklin & Marshall College: GEOL 322 Igneous and Metamorphic Petrology
Louisiana State University: Geology 3041 Igneous and Metamorphic Petrology
Millersville University of Pennsylvania: ESCI 328 Petrography/ Igneous and Metamorphic Petrology
Northwestern University: Geology 302-0 Igneous and Metamorphic Petrology
University of Maryland: GEOL 443 Igneous and Metamorphic Petrology
University of Minnesota: Geol 2312 Igneous and Metamorphic Petrology
Wayne State University: Geology 326 Igneous and Metamorphic Petrology
Whitman College: GEOL 346 Igneous and Metamorphic Petrology

A7 The ability to understand and interpret the geologic meaning of different rock types, including many igneous and metamorphic rocks, are required in order to pass many states' professional geologists licensure exams, including the one required by the state of Pennsylvania for Professional Geologist (P.G.) licensure. The National Association of State Boards of Geology publishes a handbook for aspiring Professional Geologists that summarizes the standards thy have promulgated for state licensure. Appendix A of that handbook shows that petrology and petrography are required subjects.

Appendix 2

ASBOG FG and PG Test Blueprints
Number and Percent of Items by Domain

CONTENT DOMAINS	FG#	FG%	PG#	PG%
A. Field Methods & Remote Sensing	32	29.1	28	35.0
B. Mineralogy, Petrology, Petrography, & Geochemistry	15	13.6	2	2.5
C. Sedimentology, Stratigraphy, & Paleontology	11	10.0	3	3.8
D. Geomorphology	7	6.4	5	6.3
E. Structural Geology & Tectonics	10	9.1	2	2.5
F. Geophysics & Seismology	4	3.6	4	5.0
G. Hydrogeology	27	24.5	20	25.0
H. Engineering Geology	3	2.7	9	11.3
I. Mineral, Petroleum, & Energy Resources	1	0.9	7	8.8
TOTALS	110	100.0	80	100.0

Section B: Interdisciplinary Implications

B1 This course will not be taught by instructors from more than one department.

B2 There is no relationship between the content of this course and the content of any other course offered at IUP.

B3 This course will not be cross-listed with other departments.

Section C: Implementation

C1 Faculty resources are adequate to teach this class at the current time. The course will be taught on a two-year rotation, alternating with another new controlled elective course in the workload of our mineralogist-petrologist, Dr. Nick Deardoff. Until 2008, this faculty position was assigned to teach Mineralogy and Petrology as separate classes. When a former faculty member combined these subjects into a single semester, he used the freed-up hours in his workload to offer major elective courses such as GEOS 313 Soils and Soil Geochemistry and non-major electives such as GEOS 153 Forensic Geology. We plan to keep these elective courses on the books in case of future faculty interest, but they do not need to be taught regularly. We have identified GEOS 345 Igneous and Metamorphic Petrology as a much higher priority in the course rotation, because it will help our students achieve key learning outcomes such as rock identification and interpretation.

C2 The teaching space as well as the existing igneous rock and mineral resources we have collected in the department over the past thirty years are sufficient to teach this class. We anticipate modernized teaching labs in the new science building that will assist us to update the lab and incorporate more innovative teaching techniques. We update our teaching collections of rocks and minerals at no additional cost whenever we take our students on a regional field course to areas with classic outcrops or unique examples of igneous and metamorphic rocks.

Our optical microscopes are growing old and many are not aligned well enough for students to use them easily. We are implementing a plan to replace six of them at a time using college equipment resources, so that each work table of students in the lab has access to at least one new microscope to examine optical features of the rocks in thin sections. Students supply their own hand lens for hand sample examination and pay for their meals and camping (supplemented by existing departmental foundation resources) for the three-day weekend field trip.

Library resources are adequate for this course, particularly since IUP has recently gained access to the Web of Science journal archive. Updated petrographic reference books and other resources will be added to our lab as our budget permits each year.

C3 None of the resources for this course is grant-funded.

C4 This course will be offered in alternate fall semesters, in tandem with another new course, GEOS 363 Volcanology, that is being proposed as part of this curriculum package. We offer these upper-level classes in the fall to ensure that students have had a chance to take their pre-requisite, GEOS 301 Mineralogy, in the preceding spring. The fall also gives us our best field weather for the three-day regional trips, which often go to areas of New England where the weather can be unpredictable in the spring.

C5 No more than one section of this course will be offered at a time.

C6 Since this course has an integrated laboratory section, enrollment is limited to 24 students (4 students per work-table / 6 work tables in the lab). This is the standard enrollment limit for our upper-level majors courses. Enrollments in these classes usually range from 15-22 students, although recent rises in our overall enrollment may cause them to fill in the future.

C7 We are not aware of any parameters or enrollment guidelines for this course.

C8 This is not a distance education course.

Section D: Other Miscellaneous Information

There is no additional information for this proposal.

Part III. Letters of Support or Acknowledgement

No letters of support from other programs or departments are required for this proposal.