RECEIVED
NOV 3 2000
LIBERAL STUDIES

LSC Use Only:
Number: _____
Submission Date: _____
Action Date: _____

UWUCC Use Only:
Number: 00-386
Submission Date: _____
Action Date: UWUCC App 12/19/00
Senate App 1/30/01

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT

Contact Person Keith Putirka Phone x5627
Department Geoscience

II. PROPOSAL TYPE (Check All Appropriate Lines)

_____ **COURSE** Appl Math in Geosci
Suggested 20 character title

__X__ New Course* GEOS 123, Applied Mathematics in the Geosciences
Course Number and Full Title

_____ Course Revision _____
Course Number and Full Title

_____ Liberal Studies Approval for new or existing course _____
Course Number and Full Title

_____ Course Deletion _____
Course Number and Full Title

_____ Number and/or Title Change _____
Old Number and/or Full Old Title

_____
New Number and/or Full New Title

_____ Course or Catalog Description Change _____
Course Number and Full Title

_____ PROGRAM: _____ Major _____ Minor _____ Track

_____ New Program* _____
Program Name

_____ Program Revision _____
Program Name

_____ Program Deletion* _____
Program Name

_____ Title Change _____
Old Program Name

_____
New Program Name

III. Approvals (signatures and date)

Darlene Richard
Department Curriculum Committee

_____
College Curriculum Committee

Darlene Richard
Department Chair

_____
College Dean

_____
Director of Liberal Studies (where applicable)

_____
*Provost (where applicable)

Part II

1. Description of the Curricular Change

A. Catalog Description

GEOS 123: Applied Mathematics in the Geosciences

1 lecture hour
0 lab hour
1 credit
(1c-0l-1sh)

Co-requisites: Concurrent enrollment in MATH 121 or MATH 123, or permission of instructor

For geoscience majors enrolled in either MATH 121 or MATH 123. Applications of the calculus to problems in geochemistry and geophysics. Topics will involve geoscience applications of limits, differentiation, Taylor series, exponential functions, integration and advanced topics.

B. Course Objectives

Students will

1. be able to apply the mathematical skills developed in MATH121/MATH123 to various problems in the geosciences.

2. understand the central role that mathematical functions and calculus play in the development of scientific descriptions of the oceans, atmosphere and solid Earth.

3. apply mathematics to develop and test geological models

C. Course Outline

1. Precalculus Review: Algebraic expressions in the geosciences. Examples include mantle (fluid) dynamics, gravity, diffusion, tectonics and fracture mechanics (2 hrs).

2. Limits: Applications of limits to trace element analysis heat flow and elastic constants (1 hr).

3. Differentiation: Commonly used expressions will be used to illustrate the principles of the derivative and differentiation. Geochemical examples will include mantle and atmospheric adiabats, phase boundary curves (the Clapeyron equation) and equations of state. Geophysical examples will include travel time-distance curves, heat-flow, and tidal heating (3 hrs).

4. Exponential and logarithmic expressions: Examples of exponential and logarithmic functions will focus on Arrhenius relationships with examples regarding phase equilibria, diffusion, mantle dynamics (viscosity and solid-state deformation) (2 hrs).

5. Sigma notation: Applications to geochemistry - partial molar quantities (1 hr).

6. Taylor series: An introduction to Taylor and Maclaurin Series' with applications to the calculation of a conductive geotherm (1hr).

7. Integration: Applications from geophysics include heat flow and planetary cooling, potential energy of orbiting bodies. Geochemical examples focus on enthalpy, entropy and heat capacity calculations and applications to phase equilibria (3 hrs).

8. Introduction to differential equations: An introduction to partial differential equations and applications to phase equilibria (1 hr).

D. Evaluation Methods

The final grade for this course is based on:

90% Homework assignments
10% Final pesentation (during finals week). Students will give an oral presentation regarding a geoscinece topic of their choice, illustrating the application of mathematics to the geosciences.

Grading Scale: A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; F = 0-59%.

E. Required Textbooks, Supplemental Books and Readings

All readings in this course will be taken from technical articles in the geoscience literature, research proposals and published abstracts.

F. Special Resource Requirements

None.

G. Bibliography

Anderson, D. L., 1989, Theory of the Earth: Blackwell Scientific Publications, Brookline Village, MA, 366 p.

Carr, J., 1995, Numerical analysis for the geosciences; Prentice Hall, Englewood Cliffs, NJ, 592 p.

Consolmagno, G. J., and Schaefer, M. W., 1994, Worlds Apart: A textbook in planetary sciences: Prentice Hall, Englewood Cliffs, NJ, 320 p.

Fowler, C. M. R., 1990, The solid Earth: Cambridge University Press, New York, NY, 472 p.

Langmuir, C. H., Klein, E. M., and Plank, T., 1992, Petrological systematics of mid-ocean ridge basalts: constraints on melt generation beneath ocean ridges. In: Morgan, J. P., Blackman, D. K., and Sinton, J. M., eds., Mantle Flow and Melt Generation at Mid-Ocean Ridges, Geophysical Monograph 71, AGU, Washington DC, p. 183-280.

Lillie, R. J., 1999, Whole Earth Geophysics: An introductory textbook for geologists and geophysicists: Prentice Hall, Englewood Cliffs, NJ, 361 p.

Nordstrom, D. K., and Munoz, J. L., 1986, Geochemical Thermodynamics: Blackwell Scientific Publications, Brookline Village, MA, 477 p.

Philpotts, A. R., 1990, Principles of igneous and metamorphic petrology: Prentice Hall, Englewood Cliffs, NJ, 498 p.

Poirier, J-P., 1985, Creep of crystals: high-temperature deformation processes in metals, ceramics and minerals: Cambridge University Press, New York, NY, 260 p.

Vacher, H. L., 1999, Computational Geology 6 - solving problems: Journal of Geologic Education, v. 47, p. 280-288.

H. Justification /Rationale for Curricular addition

It is well recognized that calculus is the language with which scientists construct physical models and communicate their ideas. Unfortunately, many GeoScience majors, having completed a course in calculus, fail to understand the relevance of calculus to their professional career. In part, this is due to the fact that calculus is introduced in GEOS courses only in upper-level courses. An additional problem is that many incoming freshman are not only unmotivated, but also intimidated by mathematics. This course, GEOS 123, is designed to introduce students to the geoscience applications of calculus while they are enrolled in MATH121/123, and to give some additional review and practice regarding the mathematical methods covered in these courses. We anticipate that students better appreciate the content of MA121/123, and that the additional practice in problem-solving will increase student motivation and improve performance. We furthermore hope that geoscience majors will be motivated to enroll in additional mathematics courses during their tenure at IUP.

2. Course Analysis Questionnaire

Section A: Details of the Course

A1 MA 121/123 is required of all Geoscience majors. Students are encouraged to take MA121/123 early in the program so that they are prepared for upper division coursework in the dept.

A2 This course is intended as an elective only. No changes in the program or existing courses are required.

A3 This course has not yet been offered at IUP.

A4 This is not a dual-level course.

A5 This course may not be taken for variable credit.

A6 Other universities offering a similar course: West Chester University of PA.

A7 This course is not required by any accrediting agency or any external professional society.

Section B: Interdisciplinary Implications

B1 Only one instructor will teach this course.

B2 The overall design of this course is to closely follow the syllabus of MATH121. The specific content, though, will differ from MATH121; problems related to the application of mathematical methods in the geosciences will be emphasized.

B3 Seats will be made available to the School of Continuing Education.

Part III - Letters of Support

Mathematics Department:
9/19/00

Dr. Putirka:

I have reviewed your proposal for GEOS123 Applied Mathematics in the Geosciences and I submitted it to the Mathematics Department Service Courses Curriculum Committee for their review. We are in agreement that the proposed course has the potential to enhance the understanding of calculus for geoscience students. Likewise, we feel your students may be more highly motivated to learn the calculus content when they see it's applications in their major field of study. Consequently, the faculty of the Mathematics Department support your proposal and look forward to cooperating with the faculty of the Geoscience Department in making this endeavor successful.

Gerald Buriok, Chairman
Mathematics Department