LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		10-58d.	App-4/5/11	App 4/19/11

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person	Email Address
Karen Rose Cercone	kcercone@iup.edu
Proposing Department/Unit	Phone
Geoscience	7-7650

Check all appropriate lines and complete information as requested. Use a separate cover sheet for each course proposal and for each 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

	GEOS 324 Geology of Oil & Gas
Current Course prefix, number and full title	*Proposed course prefix, number and full title, if changing*

2. Additional Course Designations: check if appropriate

____This course is also proposed as a Liberal Studies Course. _____ Other: (e.g., Women's Studies, Pan-African)

___This course is also proposed as an Honors College Course.

3. Program Proposals

_____Catalog Description Change _____Program Revision

_____New Degree Program _____Program Title Change _____Other

_____New Minor Program _____New Track

Current program name	*Proposed program name, if changing*

4. Approvals		**Date**
Department Curriculum Committee Chair(s)		11/3/10
Department Chair(s)		11/3/10
College Curriculum Committee Chair	Anne Kondo	12/3/10
College Dean	Mary Sattazahn	12/3/10
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate: (include title)		
UWUCC Co-Chairs	Gail Sechrist	4-5-11

* where applicable

1. SYLLABUS OF RECORD

I. Catalog Description

GEOS 324 Geology of Oil and Gas **3c-3l-4cr**

Prerequisites: Grade of C or better in GEOS 202 and 203

An in-depth exploration of the geological processes that create oil and gas resources in sedimentary rocks. Students will also learn specific techniques used in the oil and gas industry for locating and extracting oil and gas reserves, and study the environmental impacts caused by their development. Students will also gain an understanding of the limited nature of fossil fuels.

II. Course Objectives

At the end of this course students will be able to:

1. Identify the rock formations that are the sources of hydrocarbons and the reservoir rocks that are most likely to contain exploitable resources.
2. Interpret organic geochemical data to correlate petroleum fluids from source rock to reservoir
3. Explain what geological factors must be present to create a structural or stratigraphic trap for hydrocarbons.
4. Synthesize data from well logs and seismic surveys to contour strata and identify facies
5. Select appropriate drilling and fracturing techniques to use in different geologic settings
6. Predict possible environmental costs and limitations on hydrocarbon extraction, and choose appropriate methods to mitigate environmental damage.

III. Detailed Course Outline

Lecture Topic (3 academic hours per week except as noted)	Lab Topic (3 acad. hrs)
Week 1: Overview of current oil and gas resources ▪ Global petroleum resource distribution ▪ Supply and demand, peak oil curves ▪ The economics and history of the oil industry	Petroleum resource estimation
Week 2: The Subsurface Environment ▪ Hydrostatic and lithostatic pressure; over-pressure ▪ Geothermal gradient and plate tectonics ▪ Subsurface fluids, sediment compaction and diagenesis	Porosity and permeability in petrographic section
Week 3: The Carbon Cycle ▪ Geochemistry of carbon in the environment ▪ Chemical composition of organic matter ▪ Accumulation and decay of organic matter	Gas and liquid chromatography
Week 4: The Petroleum System ▪ Overview of petroleum formation from source to trap ▪ Biogenic natural gas versus thermogenic natural gas ▪ The destruction and breakdown of petroleum in nature	**Field Trip to Drake Oil Well Museum**

Week 5: Sedimentary Facies Interpretation ▪ Sedimentary environments & biologic productivity ▪ Well-log analysis and interpretation ▪ Subsurface facies reconstruction	Well-log analysis and correlations of strata
Week 6: Source Rock Formation and Analysis ▪ Transformation of organic matter to kerogen ▪ Kerogen composition and classification ▪ Petroleum generation and expulsion	Correlating Source Rocks to Oils
Week 7: Thermal Maturity of Organic Matter ▪ Time-temperature models of organic maturity ▪ Measuring organic maturity of source rocks ▪ Timing of oil and gas generation and migration	Basin Analysis and Maturity Studies
Week 8: Migration of Oil & Gas (2 hours) ▪ Models of non-aqueous fluid flow ▪ Primary migration versus secondary migration	Volumetric calculations of oil reservoirs
MIDTERM EXAM (1 hour)	
Week 9: Exploring for Oil & Gas ▪ Reservoir rocks: conventional and unconventional ▪ Structural versus stratigraphic traps ▪ Subsurface contouring and mapping of strata	Interpretive Stratigraphic Contouring
Week 10: Oil & Gas Production ▪ Well drilling and completion ▪ Production curves and secondary recovery ▪ Composition of crude oils	**Field Trip to a Working Oil or Gas Well Field**
Week 11: Seismic Stratigraphy and Exploration ▪ Data acquisition and processing ▪ Seismic interpretation methods ▪ 3d seismic modeling	Seismic Stratigraphy
Week 12: Other Exploration Techniques ▪ Gravity, magnetic and thermal anomaly surveys ▪ Remote sensing and hydrocarbon occurrence ▪ Fractures and lineaments in relation to oil	Project Part 1: identification of potential leased acreage
Week 13: Unconventional Sources of Petroleum ▪ Tar sands: occurrence and mining challenges ▪ Oil shales and in-situ gasification techniques ▪ Gas shales and horizontal drilling techniques	Project Part 2: specific prospect evaluation
Week 14: Environmental Impact and Risks ▪ Aqueous and non-aqueous pollution risks ▪ Groundwater plumes and remediation techniques ▪ Global warming and the carbon cycle	Project Part 3: Presentation to the drilling committee
FINAL EXAM (held during the scheduled final exam period)	

IV. Evaluation Methods

Each component of the course will contribute to final grade as follows:

Weekly Lab Exercises	20%
Midterm Exam	20%
Final Project	30%
Final Exam	30%
Total	100%

V. Grading Scale

The final grade for this course will be determined using the following schedule:
A=90-100%; B=80-89%, C=70-79%, D=60-69%, F=<60%

VI. Attendance Policy

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

VII. Course Textbook and Other Resources

The main textbook used in this course will be ***Elements of Petroleum Geology (2nd Edition)*** by Richard C. Selley (Elsevier, 1997). This is the only specialized survey text appropriate for an undergraduate level class. Additional articles may be assigned from The American Association of Petroleum Geologists Journal to keep students up to date on new developments in drilling and new production techniques such as hydraulic fracturing. Websites and online publications from the federal Environmental Protection Agency and the state Department of Environmental Protection will be used to acquaint students with current oil and gas regulations.

VIII. Special Resource Requirements

All students will be asked to purchase steel-toed boots in order to comply with OSHA requirements when they visit working oil and gas drilling sites. There is no lab fee associated with this course.

IX. Bibliography

Texts and Reference Books

Barker, Colin (1997) Thermal Modeling of Petroleum Generation: Theory and Applications. Developments in Petroleum Science 45. Elsevier, 526 pages.

Darling, Toby (2005) Well Logging and Formation Evaluation. Gulf Professional Publishing, 336 pages.

Evenick, Jonathan (2008) Introduction to Well Logs and Subsurface Maps. Pennwell Corporation, 254 pages.

Gluyas, Jon and Richard Swarbrick (2003) Petroleum Geoscience. Wiley-Blackwell, 376 pages.

Kearey, Phillip, Michael Brooks & Ian Hill (2003) An Introduction to Geosphysical Exploration (3rd Edition) . Wiley-Blackwell, 272 pages.

Krygowski, Daniel, George B, Asquith, and Charles Gibson. (2004) Basic Well Log Analysis (2nd Edition). American Association of Petroleum Geologists Methods in Exploration Series No. 3, 244 pages.

Selected Journal Articles

Abousleiman, Younane , Minh Tran, Son Hoang, J. Alberto Ortega, and Franz-J. Ulm (2010) Geomechanics field characterization of Woodford Shale and Barnett Shale with advanced logging tools and nano-indentation on drill cuttings. The Leading Edge, 29: 730 - 736.

Bratvold, Reidar B. and Steve H. Begg (2008) I would rather be vaguely right than precisely wrong: A new approach to decision making in the petroleum exploration and production industry. AAPG Bulletin, 92: 1373 - 1392.

Engelder, Terry, Gary G. Lash, and Redescal S. Uzcátegui (2009) Joint sets that enhance production from Middle and Upper Devonian gas shales of the Appalachian Basin. AAPG Bulletin, 93: 857 - 889.

Klett, T.R. Donald L. Gautier, and Thomas S. Ahlbrandt (2005) An evaluation of the U.S. Geological Survey World Petroleum Assessment 2000: AAPG Bulletin, 89: 1033 - 1042.

Kontorovich, Alexey E. , Viktor I. Dyomin, and Valery R. Livshits (2001) Size Distribution and Dynamics of Oil and Gas Field Discoveries in Petroleum Basins. AAPG Bulletin, 85: 1609 - 1622.

Law, Ben E.. (2002) Basin-Centered Gas Systems. AAPG Bulletin, Nov 2002; 86: 1891 - 1919.

Pollastro, Richard M. (2007) Total petroleum system assessment of undiscovered resources in the giant Barnett Shale continuous (unconventional) gas accumulation, Fort Worth Basin, Texas. AAPG Bulletin, 91: 551 - 578.

Quirk, David G. and Richard G. Ruthrauff (2008) Toward consistency in petroleum exploration: A systematic way of constraining uncertainty in prospect volumetrics: AAPG Bulletin, 92: 1263 - 1291.

Smalley, P. Craig, Stephen H. Begg, Michael Naylor, Sigrunn Johnsen, and Antonella Godi (2008) Handling risk and uncertainty in petroleum exploration and asset management: An overview. AAPG Bulletin, 92: 1251 - 1261.

Vanorio, Tiziana, Tapan Mukerji, and Gary Mavko (2008) Emerging methodologies to characterize the rock physics properties of organic-rich shales. The Leading Edge, 27: 780 - 787.

Course Analysis Questionnaire

Section A: Details of the Course

A1. How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

This upper-level majors course will become part of the required core for a new Energy Resources track for our Geology degree, and will also count as an upper-level elective for students in the Geology and Environmental degree tracks. This course is designed to prepare IUP geoscience students for the technical demands of oil and gas resource development prior to taking an internship or job within the oil and gas industry. The content of this course is unique to oil and gas exploration and development (i.e. organic geochemistry, source rock evaluation, well-logging and seismic stratigraphy) and cannot be incorporated in any existing geoscience class.

A2. **Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.**
A separate proposal for the Energy Resources track which requires this as a core course is being submitted in conjunction with this course proposal. GEOS 322 can also be taken as a controlled elective by students in the Geology and Environmental Geoscience tracks; no alterations to their program descriptions are required, as they currently allow any courses numbered at the GEOS 300-level to count as controlled electives.

A3. **Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).** No.

A4. **Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.** No.

A5. **If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?** It will not be taken for variable credit.

A6. **Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).**
Yes, many other geoscience departments our size or larger offer a specialized course in oil & gas or petroleum geology. Some examples include:

Penn State University: GEOSC 454 Geology of Oil and Gas (3 hours)
West Virginia University: GEOL 472. Petroleum Geology. (3 hours)
Marietta College of Ohio: GEOL 326 Petroleum Geology. (4 hours)
South Dakota State University: GEOS 521 Petroleum Geology (4 hours)

A7. **Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.** No.

Section B: Interdisciplinary Implications

B1. **Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.** No.

B2. **What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).**
There are no other courses at IUP that cover this material.

B3. **Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.** No.

B4. Will seats in this course be made available to students in the School of Continuing Education? No.

Section C: Implementation

C1. Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.
We have been authorized to hire a specialist in petroleum exploration and resource development to support the implementation of the new Energy Resources track and to teach this course among others. No existing courses will be affected in any way by this one.

C2. What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:
*Space: we have adequate space for teaching this class
*Equipment: we have adequate equipment (maps, core samples) for teaching this class
*Laboratory Supplies and other Consumable Goods: we have sufficient lab supplies
*Library Materials: we have adequate access to oil & gas journals
*Travel Funds: we can use our departmental vans for transporting students to field sites as noted in the syllabus

C3. Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.) No.

C4. How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?
Like all of our other upper-level electives, this course will be offered in alternate years to combine junior-senior demand into a single larger section.

C5. How many sections of this course do you anticipate offering in any single semester?
One.

C6. How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?
We can accommodate up to 24 students. This limitation is based on the number of lab and van seats and is similar to all of our other science courses.

C7. Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents. No

C8. If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.
It is not a distance education course.

Section D: Miscellaneous

Include any additional information valuable to those reviewing this new course proposal.

The immense reserve of shale-hosted natural gas in the Appalachian Basin (the Marcellus Play, estimated by some to be the largest natural gas reserve in the world) has created a booming industry in Pennsylvania as well as adjacent states. This class, and the new Energy Resources Track it is part of, are being proposed in order to meet the growing demand for trained geologists by companies expanding their operations in Pennsylvania. By adding this specialized training to the classic field training that the IUP Geoscience Department is well known for among local oil and gas companies, IUP undergraduates can become as competitive for jobs in the Marcellus industry as students with master's degrees from other institutions.