P3-202

THE FACULTY SENATE

March 16, 2009

MEMORANDUM

TO: Dr. Elsa Murano, President

FROM: Clint Magill, Speaker

SUBJECT: Approval of Graduate Council Item **(FS.26.91)**

At its regular meeting on March 9, 2009 the Faculty Senate approved the following curriculum item from the Graduate Council. The Faculty Senate submits it for your approval. Attached is a copy of the material sent to our Senators.

Graduate Council

Special Consideration - February 5, 2009

Proposal to Initiate a Graduate Certificate Program in Petroleum Geoscience

Thank you for your time and consideration. Please inform me of your action on this matter.

Attachment

cc: Jeffrey S. Vitter
Karan Watson
Paul Meyer
Sandra Williams
Robert Webb
David Reed
Bjorne Kjerfve

RECEIVED
APR 08 2009
CURRICULUM SERVICES

Approved:

Dr. Elsa Murano, President — Date 4/7/09

TEXAS A&M UNIVERSITY 1225 TAMU COLLEGE STATION, TEXAS 77843-1125 TEL. 979/845-9528 FAX. 979/845-6445
senate@tamu.edu http://facultysenate.tamu.edu

TEXAS A&M UNIVERSITY
DEPARTMENT OF GEOLOGY & GEOPHYSICS
COLLEGE STATION, TEXAS 77843-3115
Telephone (979) 845-2451
Fax (979) 845-6162

SC601

Oct. 30, 2008

MEMORANDUM

TO: Dr. Sarah Bednarz
Chair, GIUCC and
Assoc Dean for Academic Affairs, College of Geosciences

FROM: Andreas Kronenberg
Professor and Head, Department of Geology and Geophysics

XC: Dr. David Wiltschko
Professor, Department of Geology and Geophysics

SUBJECT: Proposal to initiate a Graduate Certificate Program in Petroleum Geoscience

Enclosed please find a proposal by the Department of Geology and Geophysics to initiate a new Certificate Program at the graduate level in Petroleum Geosciences. The intention is to restrict this program to degree-seeking students who finish their Geology or Geophysics MS (or PhD) degree requirements, using this certificate to highlight the strength of the student's background in disciplines that have application in the oil and gas industry. In addition to any degree plan requirements for the degree, students receiving this certificate will need to meet criteria outlined in the certificate program. We have received favorable responses from the Deartment's Advisory Council and from the Department of Petroleum Engineering of Texas A&M University; please see the memorandum provided by Dr. Stephen Holditch, Department Head of Petroleum Engineering.

I understand that this proposal must ultimately be submitted to the Office of Graduate Studies, following approval by your committee and the Dean of the College of Geosciences. Please feel free to contact me if there are any supplementary materials that you need for your evaluation.

Department of Geology and Geophysics Graduate Certificate Program in Petroleum Geoscience

Introduction

The Graduate Certificate Program in Petroleum Geoscience is an interdisciplinary program restricted to graduate students in the Department of Geology & Geophysics (G&G) designed to enhance both critical thinking and technical skills that serve as the scientific foundation for practicing petroleum geoscience. The program requires students complete 18 semester credit hours from G&G and, optionally, Petroleum Engineering (PETE). The courses are taken as part of the regular graduate program. The Certificate is conferred upon successful completion of the required courses and the MS or PhD in G&G.

Rationale

This certificate is designed to highlight a student's skills and depth of knowledge of disciplines that have application in the oil and gas industry. The program was developed with support and guidance from the Department of Geology & Geophysics Advisory Council and in consultation with industry recruiters. It meets strategic goals for the Department and the College of Geosciences, and addresses key issues related to student employability. It has the support of the Department of Petroleum Engineering.

Certificate Requirements

This graduate certificate is an 18 credit program consisting of the following courses:

Course	Title and Description	Credit Hours
GEOP 622 or 629	Petroleum Seismology or Seismic Interpretation	4
GEOL 622	Stratigraphy	3
GEOL 612	Structural Geology	3
GEOL 624, 665 or 668	Carbonate Reservoirs or Structural Petrology or Classic Sedimentology and Sedimentary Petrology	3, 4, 4
GEOL/GEOP 681	One Petroleum Geoscience Seminar per year	1
	One additional course related to Petroleum Geoscience from the list Supplemental Petroleum Geoscience courses	3 or 4
TOTAL HOURS		18 +

Paragraph to be Added to the Graduate Catalogue

The Graduate Certificate in Petroleum Geoscience is an interdisciplinary program in the Department of Geology and Geophysics designed to enhance both critical thinking and the technical skills that serve as the scientific foundation for practicing petroleum geoscience. The program requires a minimum of 18 semester credit hours from Geology and Geophysics and optionally Petroleum Engineering as part of a regular graduate program. In addition, workshops, lectures and field trips enable students to learn about pressing scientific problems in petroleum exploration and production. Students are required to take a core of courses including reflection seismology and seismic interpretation, sequence stratigraphy and basin analysis, 3-D structure, rock properties and one seminar per year are required. In addition, students must choose at least one course from an approved list of supporting courses in both the Department of Geology and Geophysics and Petroleum Engineering. The Certificate is conferred upon successful completion a MSc or PhD degree program in Geology and Geophysics including the required courses. For detailed information please contact the graduate advisor, Department of Geology and Geophysics or send an e-mail to petroboss@geoweb.tamu.edu.

Contact:

Dr. Andreas Kronenberg
Professor and Head
Department of Geology and Geophysics
Phone: (979) 845-0132; FAX: (979) 845-6162
e-mail:kronenberg@geo.tamu.edu
College Station, TX 77843-3115

Texas A&M University
Department Request for a New Graduate
Certificate Program

1. **This certificate request is submitted by the Department of Geology and Geophysics.**

2. **Complete Title of Certificate: Certificate in Petroleum Geoscience.**

3. **Paragraph for catalog:**

   The Graduate Certificate in Petroleum Geoscience is an interdisciplinary program in the Department of Geology and Geophysics designed to enhance both critical thinking and the technical skills that serve as the scientific foundation for practicing petroleum geoscience. The program requires a minimum of 18 semester credit hours from Geology and Geophysics and optionally Petroleum Engineering as part of a regular graduate program. In addition, workshops, lectures and field trips enable students to learn about pressing scientific problems in petroleum exploration and production. Students are required to take a core of courses including reflection seismology and seismic interpretation, sequence stratigraphy and basin analysis, 3-D structure, rock properties and one seminar per year are required. In addition, students must choose at least one course from an approved list of supporting courses in both the Department of Geology and Geophysics and Petroleum Engineering. The Certificate is conferred upon successful completion a MSc or PhD degree program in Geology and Geophysics including the required courses. For detailed information please contact the graduate advisor, Department of Geology and Geophysics or send an e-mail to petroboss@geoweb.tamu.edu.

4. **Is the certificate in a disciplinary area where Texas A&M University already offers degrees? Yes**

5. **How many hours are in the certificate ? 18**

6. **Is the certificate potentially going to be offered as a stand-alone certificate program to students at other locations than the Texas A&M University Campus? No**

7. **Is the certificate program going to be available through Distance Education? No**

Approval recommended by:

Oct. 29, 2008
Head of Department **Date**

12/3/08
Chair, College Review Committee **Date**

Head of Department (if cross-listed course) Date

12/3/08
Dean of College **Date**

Submitted to Coordinating Board by:

Dean, Office of Graduate Studies **Date**

Date **Effective Date**

TEXAS A&M
THE HAROLD VANCE DEPARTMENT OF
PETROLEUM ENGINEERING

Stephen A. Holditch, P.E.
Noble Endowed Chair
Department Head
(979) 845-2255
holditch@tamu.edu

Oct. 27, 2008

MEMORANDUM

TO: Andreas Kronenberg
Head, Department of Geology and Geophysics

FROM: Stephen A. Holditch Stephen A. Holditch
Head, Department of Petroleum Engineering

XC: Brenda H. Thomas
Director, Office of Graduate Studies

SUBJECT: Support of New Certificate in Petroleum Geosciences

With this memorandum, the Harold Vance Department of Petroleum Engineering offers its support for the proposed Graduate Certificate in Petroleum Geosciences based in the Department of Geology and Geophysics, College of Geosciences. We have developed a collaborative relationship with the Geology and Geophysics Department, both in teaching and research. I expect that this new Certificate program will help to improve and strengthen this relationship. An important part of the program is its flexibility in both course selection, including Petroleum Engineering courses, and enhancement programs such as professional workshops and short courses.

We look forward to working with the Department of Geology and Geophysics so that students in both that Department and Petroleum Engineering may seamlessly interact in courses and other training environments. Let me know if you have any questions.

Graduate Certificate in Petroleum Geoscience
Department of Geology and Geophysics

Requirements

Completing all requirements for MSc or PhD in Department of Geology and Geophysics
GEOP 622 or 629 (a course in reflection seismology)
GEOL 622 (sequence stratigraphy / basin analysis)
GEOL 612 (structural geology)
GEOL 624, 665, or 668 (A course in rock properties)
One GEOL/GEOP 681 per year (Petroleum Geoscience Seminar)
One additional course related to Petroleum Geoscience. See attached List of Supplemental Petroleum Geoscience courses.

Course #	*Title*	*Description*
GEOL 619	Petroleum Geology. (3-0)	Properties of reservoir rocks; origin, migration and accumulation of petroleum; geologic interpretation of borehole logs and fluid-pressure measurements and the role of hydrostatic and hydrodynamic pressures in oil accumulation. Prerequisite: Approval of instructor.
GEOL 623	Carbonate Rocks. (3-0)	Principles of carbonate sedimentology; carbonate depositional sequences defined in modern environments and utilized to interpret the rock record; introduction to depositional and diagenetic microfacies; shelves, ramps and isolated platforms and their tectonosedimentary significance; suggested for geoscience majors. Prerequisites: A basic understanding of sedimentology and the associated terminology; graduate classification.
GEOL 624	Carbonate Reservoirs	Recognition and description of hydrocarbon reservoirs in carbonate rocks; classification of carbonate porosity; capillary pressure curves and pore types; pore characteristics as proxies for permeability in reservoir modeling; techniques for mapping flow units. Prerequisites: Graduate classification and approval of instructor
GEOL 625	Applied Ground Water Modeling. (3-0)	Concept of groundwater flow and contaminant transport; numerical simulations of solving flow and transport equations; finite difference and finite element methods; software structures of groundwater flow, contaminant transport, density-dependent fluid flow and hydrocarbon remediations; real case applications of software including geological, physical, chemical, biological and hydrological information. Prerequisite: GEOL 410 or approval of instructor.
GEOL 629	Tectonics ('Regional Geology of North America')	Introduction to plate tectonic processes at plate margins; tools for unraveling tectonic history: geochronology, paleomagnetism, tectonic significance of rock types and chemical tracers; the earliest plates; Paleozoic mountain belts of North America and Europe; western Pacific: the present is the key to the past; Gulf of Mexico; evolution of the Cordillera, Montana to Mexico. Prerequisite: Graduate classification or approval of the instructor.
GEOL 645	Geochronology	Methods of dating both the physical and biological changes preserved in rocks; primary tools of numerical (radiometric) dating techniques, correlation methods and isotope stratigraphy; evaluation of the precision and accuracy of radiometric age dates and their constraints on geologic time scales, as well as evaluating the correlations of sedimentary strata.
GEOL 646	Biogeochemical Cycling in Subsurface Systems.	Fundamental concepts and research techniques in the study of coupled biogeochemical cycles; focus on connections between major elemental cycles of carbon oxygen, hydrogen, nitrogen, sulfur, phosphorus, and metals including biotic and abiotic transformations in subsurface systems. Prerequisite: Graduate classification.
GEOL 648	Stable Isotope Geology. (2-3)	Stable isotopes of oxygen, carbon, sulfur and hydrogen applied to problems in paleontology and paleoecology, carbonate diagenesis, petroleum exploration, and igneous and metamorphic petrology; isotopic paleotemperatures; analytical methods; theory of isotopic fractionation. Prerequisite: GEOL 451 or approval of instructor.
GEOL 650	Paleoecology. (2-3)	Interrelationships of organisms and environment in the fossil record; methods and criteria available for interpreting ancient environments; critical review of classical studies and current research in paleoecology. Prerequisite: Approval of instructor.
GEOL 664	Mechanical Analysis in Geology. (3-0).	Mechanical analysis of geological problems based on concepts of stress, strain, strength, elasticity, viscosity and plasticity; folding, faulting, dike formation, hydraulic fracturing, magma and glacial flow, and cooling of magmatic bodies. Prerequisites: MATH 253; approval of instructor.

GEOL 665	Structural Petrology. (3-3)	Mechanisms of rock deformation from single crystal to mountain range; techniques for mapping stresses and strains and for inferring physical conditions and mechanical behavior at time of deformation; laboratory assignments on descriptive techniques include petrographic microscope-universal stage methods, field procedures and data analysis. Prerequisite: Approval of instructor.
GEOL 668	Clastic Sedimentology and Sedimentary Petrology. (3-3)	Detailed analyses of clastic sedimentary rocks: relationships of facies and depositional environments with emphasis on continental, coastal and shallow shelf clastic sediments; petrography and diagenesis of modern and ancient clastic sediments. Prerequisites: Optical mineralogy course and sedimentology (undergraduate); graduate classification.
GEOL 689	Applied Micropaleontology	Major microfossils groups, foraminifera, nannofossils, radiolarians, diatoms, ostracods, and palynology; mode of life and application to studies of climate change, paleoceanography, paleoecology, evolution, stratigraphy and oil and gas exploration.

GEOP 620	Geophysical Inverse Theory. (3-0)	Inferences about Earth structure from geophysical data; explicit treatment of sparse and noisy observations; construction of smooth Earth models; linear inversion of marine magnetic anomalies from seafloor magnetization; smooth inversion of DC sounding data from electrical structure; seismic tomography and geodetic fault-plane reconstructions; advanced methods for nonlinear deterministic inversion. Prerequisite: Graduate classification.
GEOP 622	Petroleum Seismology II. (3-2)	Sampling (wavefield sampling); F-K analysis (applications to dip filtering and migration); deconvolution (deterministic and predicative); velocity estimation and tomography (travel time inversion); imaging in time and depth (migration); Zoeppritz equations and AVO analysis. Prerequisite: GEOP 421 or approval of instructor.
GEOP 661	Reservoir Rock Physics	Poroelasticity; connectivity tensors; fractured porous media; Biot theory and extensions; seismic attributes and rock properties; extracting fluid flow properties from seismic data.
GEOP 628	Basin Architecture. (3-0)	Tectonic classification of basins; tectonic mechanisms responsible for basin formation: mechanical behavior of the lithosphere; subsidence; geophysical signatures of sedimentary basins; tectonic controls on sedimentation and basin filling; petroleum systems and basin-scale hydrologic systems. Prerequisite: Approval of instructor.
GEOP 629	Seismic Interpretation. (3-3)	Introduces students to the problem of converting seismic properties of reflection time, velocity, impedance, amplitude and phase to geologic parameters of lithology, structures and stratigraphy using both models and real data. Prerequisite: Approval of instructor.
GEOP 630	Interactive Seismic Interpretation. (0-3).	Introduces students to computerized interpretation used in modern exploration and reservoir studies. Prerequisite: GEOP 629 or concurrent enrollment or approval of instructor.
GEOP 655	Borehole Acoustics. (3-0)	Introduces propagation of acoustic waves in boreholes, with applications to petroleum exploration and comparisons to other waveguide phenomena in the earth sciences; survey of full waveform acoustic logging and influence of borehole modes for crosswell and vertical seismic profile experiments; exercised in data analysis with industry software. Prerequisite: GEOP 421 or 652 or approval of instructor.
GEOP 666	Principles of Geodynamics. (4-0)	Structure, composition and physical state of the Earth's interior; constraints on models of the Earth imposed by seismic, gravity, heat flow, and electrical conductivity; thermodynamics and high pressure mineral physics; Earth's motion and deformation; rheology. Prerequisite: graduate classification.

PETE 400	Reservoir Description	As an effective member of a multidisciplinary team, develop reservoir descriptions and optimize reservoir depletion plans for typical hydrocarbon reservoirs, using commercial reservoir description and reservoir modeling software and data commonly available in industry, and effectively communicate study results and problem solutions in oral and written forms.
PETE 608	Well Logging Methods. (3-0)	Well logging methods for determining nature and fluid content of formations penetrated by drilling. Development of computer models for log analysis.
PETE 612	Unconventional Oil and Gas Reservoirs. (3-0)	As conventional oil and gas resources are depleted, unconventional resources, including heavy oil and gas from low-permeability sandstones, fractured shales, coal bed, and hydrates, will assume greater roles in meeting USA and world energy demands; this course emphasizes resources, geologic and geographic occurrences, recovery technology and economics of unconventional hydrocarbon resources. Prerequisite: Graduate classification in petroleum engineering, geology or geophysics.
PETE 617	Petroleum Reservoir Management. (3-0).	The principles of reservoir management and application to specific reservoirs based on case studies presented in the petroleum literature.
PETE 619	Naturally Fractured Reservoirs. (3-0)	This course is intended to explore all relevant subject matter in naturally fractured reservoirs; naturally fractured reservoirs are commonplace throughout the world, however there is a general lack of understanding of such reservoirs. This course provides the background for all relevant topics such as characterization, fluid flow, simulation and enhanced oil recovery. Prerequisite: Approval of instructor.
PETE 620	Fluid Flow in Petroleum Reservoirs. (3-0).	Analysis of fluid flow in bounded and unbounded reservoirs, wellbore storage, phase redistribution, finite and infinite conductivity fractures; dual-porosity systems. Prerequisites: PETE 323.
PETE 631	Petroleum Reservoir Description. (3-0)	Engineering and geological evaluation techniques to define the extent and internal character of a petroleum reservoir; estimate depositional environment(s) during the formation of the sedimentary section and resulting effects on reservoir character. Prerequisites: PETE 324 and 620.
PETE 663	Formation Evaluation and the Analysis of Reservoir Performance. (3-0)	Current methodologies used in geological description/analysis, formation evaluation (the analysis/interpretation of well log data), and the analysis of well performance data (the design/analysis/interpretation of well test and production data); specifically, the assessment of field performance data and the optimization of hydrocarbon recovery by analysis/interpretation/integration of geologic, well log, and well performance data. Prerequisite: Approval of instructor or graduate classification.
PETE 664	Petroleum Project Evaluation and Management. (3-0).	Introduction to oil industry economics, including reserves estimation and classification-, building and using reservoir models, developing and using reservoir management processes, managing new and mature fields, and investment ranking and selections.