



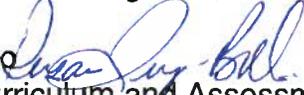
**College of Engineering**

122 Hitchcock Hall  
2070 Neil Avenue  
Columbus, OH 43210-1278

Phone 614-292-2651  
FAX 614-292-9379  
E-mail engosu@osu.edu

Date: 18 May 2017

To: Randy Smith  
Vice Provost for Academic Programs, Office of Academic Affairs (OAA)

From: Rosie Quinzon-Bonello   
Assistant Dean for Curriculum and Assessment and Secretary for the College  
Committee on Academic Affairs (CCAA)

Subject: Petroleum Engineering Minor

CCAA has reviewed and approved the attached proposal for Chemical and Biomolecular Engineering's Minor in Petroleum Engineering on 16 May 2017. I am forwarding the proposal for review and final approval by the Council on Academic Affairs. If you have any questions concerning this proposal, please let me know.

The Ohio State University  
College of Engineering  
Proposal for a

## **Petroleum Engineering Minor**

04/26/17

**Background and Content:** Petroleum Engineering is the science of dealing with oil and gas industry in three different major sectors: Upstream, midstream, and downstream. Upstream comprises exploration and production, which includes searching for potential underground or underwater crude oil and natural gas fields, drilling exploratory wells, and subsequently drilling and operating the wells that recover and bring the crude oil and/or raw natural gas to the surface. Midstream involves the transportation (by pipeline, rail, barge, oil tanker or truck), storage, and wholesale marketing of crude or refined petroleum products. Downstream refers to the refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas.

*The main learning objectives of the minor are:*

- 1) Expose students to the main petroleum engineering subjects, especially for the upstream sector.*
- 2) Equip students with an understanding of the vocabulary and engineering fundamentals needed to succeed in the oil & gas industry*
- 3) Increase their involvement in the petroleum industry, and build knowledge about the current practices and issues related to the petroleum industry.*

Key topics include:

- Petroleum origin and migration, major oil and gas fields,
- Major oil provinces of the world reviewed from the standpoints of geologic and depositional environment, and of diagenetic changes affecting petroleum entrapment,
- Drilling and production methods, petroleum composition and phase behavior,
- Reservoir engineering methods of oil resource estimation and optimization,
- Rock and fluid properties and interactions, P-V-T behavior of crude oil and natural gas,
- Fundamentals of fluid flow through subsurface porous media, and reservoir energy,
- Volumetric behavior and equations of state representation of petroleum fluids,
- Thermodynamics phase equilibrium of binary and multicomponent systems, experimental techniques for phase equilibrium measurements,
- Enhanced oil recovery and hydraulic fracturing techniques,
- Economic analysis and investment decision methods in petroleum and mineral extraction industries.

**Student Interest:** Student interest in petroleum engineering already exists on campus demonstrated by the existence of two student organizations: Buckeye Shale Energy Organization (BSEO) and a student chapter of the Society of Petroleum Engineering (SPE). These groups have significant numbers of student members, and very active involvement inviting the oil and gas industry representatives as guest speakers to increase students' awareness of the petroleum industry. Further, two research centers at OSU are focused on shale gas and unconventional resources: SERC (Subsurface Energy and Research Center), and USEEL (Utica Shale Energy and Environment Laboratory). These centers are a part of a cooperative agreement among OSU, Penn State University and West Virginia University towards the development of Marcellus and Utica shale deposits.

National energy companies recruit students from Ohio State including Marathon Petroleum (based in Ohio), Shell, ExxonMobil and BP. Many of the affiliated service companies also recruit from Ohio State including Baker Hughes, Halliburton, Schlumberger and others. These companies have confirmed that a minor program (as opposed to a full degree) would be the appropriate additional education to give students a strong start in this industry.

The subject matter builds on engineering and scientific backgrounds and as such the minor is designed to serve students from engineering and the School of Earth Sciences. We expect that the strongest interest will come from students in the School of Earth Sciences, Chemical Engineering, Civil Engineering, and Mechanical Engineering.

**Requirements for the Minor:** The successful completion of the Minor requires completing 15 credit hours. The Petroleum Engineering Minor is composed of three parts:

1. The successful completion of Petroleum Geology (EARTHSC 5661) as a co-requisite to the Introduction to Petroleum Engineering course,
2. The successful completion of three Petroleum courses, as follows: Introduction to Petroleum Engineering (CBE 5200), Petroleum Reservoir Engineering (CBE 5210), and Petroleum Drilling and Production Engineering (CBE 5230).
3. The successful completion of one elective course. Additional elective courses are available depending on the demand and for future consideration, such as Petroleum Rock and Fluid Properties (CBE 5420), Enhanced Oil Recovery (CBE 5250), Petroleum Project Evaluation (CBE 5260), Quantitative Reservoir Modeling (EARTHSC 5751), and Energy Geophysics (EARTHSC 5687).

Completion of Petroleum Geology (EARTHSC 5661) is established to assure students have the fundamental geological skills for success in the minor.

Requirements for completion of the minor are summarized in the following table.

<b>Petroleum Engineering Minor: Curricular Requirements</b>	
<b>Petroleum Engineering Core Courses (Four Courses)</b>	<b>Credits</b>
1. EARTHSC 5661 - Petroleum Geology	3
2. CBE 5200 - Introduction to Petroleum Engineering	3
3. CBE 5210 - Petroleum Reservoir Engineering	3
4. CBE 5230 - Petroleum Drilling and Production Engineering	3
<b>Elective Courses (Five Courses) Choose one</b>	<b>Credits</b>
1. EARTHSC 5751 – Quantitative Reservoir Modeling	3
2. EARTHSC 5687 - Energy Geophysics	3
3. CBE 5240 - Petroleum Rock and Fluid Properties	3
4. CBE 5250 - Enhanced Oil Recovery	3
5. CBE 5260 - Petroleum Project Evaluation	3

**Administration and Oversight of Minor:** The minor will be administered by the Department of Chemical and Biomolecular Engineering. The academic advising staff in that department will serve as coordinators for the minor.

### General Guidelines

- Required for graduation: No
- Credit hours required: A minimum of 15 credit hours. At least 6 credit hours must be at the 3000 level or above
- Filing Minor Form: The student must fill out the Minor Student Information Form (see below) with all required information, and get this approved by the Minor Advisor.
- Changing the minor: Once the minor has been filed, any changes must be approved by the Minor Advisor. This form is available on the College of Engineering website
- Grades required: No grade below a C- will be permitted in courses comprising the minor
- A minimum 2.00 cumulative point-hour ratio is required for the minor
- Course work graded Pass/Non-pass cannot count on the minor
- Transfer credit hours allowed: No more than 6 hours of transfer credit may be applied to the minor
- Overlap with GE courses: No more than 6 hours can overlap

Overlap with the major and additional minor(s): The minor must be in a different subject from the major (as identified by the registrar's official listing of approved majors). Each minor completed must contain a minimum of 12 hours distinct from the major and/or additional minors

**Existing Programs at Other Institutions:** The following three existing related curricular programs of note have somewhat related programs. Although they are focused somewhat differently based on local conditions, they have been instructive in the formation of this proposal.

1. Oklahoma State University (Petroleum Engineering Minor Program)  
[https://che.okstate.edu/content/petroleum\\_minor](https://che.okstate.edu/content/petroleum_minor)
2. University of Pittsburgh (Petroleum Engineering Minor Program)  
<http://www.engineering.pitt.edu/Departments/Chemical-Petroleum/Content/Undergraduate/Minors/>
3. University of Houston  
<http://www.petro.uh.edu/undergraduate/minor>

### Assessment Plan

The Chemical and Biomolecular Engineering (CBE) Curriculum Committee and minor coordinator will be charged with assuring the assessment of the minor. An assessment survey will be administered by the Minor Coordinator to students once they complete all requirements of the Petroleum Engineering minor. This assessment will address 1) the attainment of the learning objective for the minor, 2) structure, availability, and appropriateness of courses in the minor and 3) the students' experiences completing the minor. Completion of this assessment will be the students' last step in successfully finishing the minor requirements. This data, along with enrollment data, will be reviewed annually by the CBE Engineering Curriculum Committee.

### Proposal Authors:

Ilham El-Monier,  
David Tomasko ,

<b>Required Courses</b>					
<b>Offering Unit</b>	<b>Course #</b>	<b>Title</b>	<b>Cr</b>	<b>Pre-requisites</b>	<b>Description</b>
EARTHSC	5661	Petroleum Geology	3	4423 or 6423; and 4502 or 6502; or permission of instructor	The formation, accumulation, and trapping of oil and natural gas. Geologic source beds and traps; hydrocarbon flow; hydraulic properties of reservoirs and confining units; hydrocarbon chemistry; thin-section analysis of reservoir rocks.
CBE	5194* (5200**)	Intro to Petroleum Eng	3	Co-requisite: EARTHSC 5661	Introduction to petroleum engineering, including fundamental petroleum engineering concepts, quantities and unit systems, petroleum geology, exploration, drilling, reservoir engineering, fluids and rock properties, production, well testing, enhanced/Improves oil recovery,
CBE	5194* (5210**)	Petroleum Reservoir Eng	3	EARTHSC 5661 and CBE 5194 (5200)	Determination of reserves; material balance methods; aquifer models; fractional flow and frontal advance; displacement, pattern, and vertical sweep efficiencies in waterfloods; enhanced oil recovery processes; design of optimal recovery processes.
CBE	5194* (5230**)	Petroleum Drilling & Production Eng	3	EARTHSC 5661 and CBE 5194 (5200)	Introduction to petroleum drilling systems, including fundamental petroleum engineering concepts, quantities and unit systems, drilling rig components, drilling fluids, pressure loss calculations, casing, well cementing, and directional drilling. Fundamental production engineering design, evaluation and optimization for oil and gas wells, including well deliverability, formation damage and skin analysis, completion performance, and technologies that improve oil and gas well performance (artificial lift and well stimulation).
* temporary    **proposed permanent course number					

The School of Earth Sciences  
Ohio State University  
2/15/2017

Dear Professor El-Monier,

The School of Earth Sciences appreciates and supports the development of the Petroleum Engineering Minor within the Department of Chemical and Biomolecular Engineering. This letter is to confirm the support of Earth Sciences for that Minor and to confirm the permission of Earth Sciences Department to allow engineering students in the minor to enroll in EARTHSC 5661 without the listed pre-requisites for the course (i.e. allow the permission of instructor to apply). EARTHSC 5661 will be a co-requisite to take the Introduction to Petroleum Engineering course in the Petroleum Minor program in the Spring Semester.

Additionally, the school agrees to allow EARTHSC 5661 to serve as a pre-requisite for EARTHSC 5751 and EARTHSC 5687 to allow the students to use the latter courses as electives for the minor.

Sincerely,

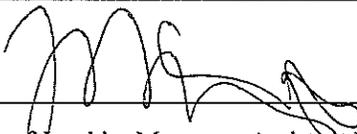
- 
- The academic unit (Earth Sciences) *supports* the proposal  
 The academic unit (Earth Sciences) *does not support* the proposal.

Please explain:

WBYMS, Director SES

- 
- The academic unit suggests:

---

  
Signature of Joachim Moortgat, Assistant Professor

---

  
Signature of Ann Cook, Assistant Professor

---

  
Signature of Thomas Darrah, Assistant Professor

Elective Courses					
Offering Unit	Course #	Title	Cr	Pre-requisites	Description
EARTHSC	5751	Quantitative Reservoir Modeling	3	2245 and Math 1152 or permission of instructor. (5661 for Petroleum Minor students)	Multiphase flow through porous subsurface media. Differential equations for transport (the continuity equation) and flow (Darcy's law), which govern a multitude of interesting problems in Earth Sciences and in various Engineering disciplines. Different forms of the continuity equation describe pure advection (e.g., pollutant transport down a river, or heat advection in oceans or the atmosphere), convection-diffusion (e.g., the diffusive transport of pollutants in groundwater from high to low concentrations), or the full Navier-Stokes equation, which describes (viscous) flow of air around an airplane wing, the weather, and ocean currents. Darcy's law describes flow in porous media, and with different variables becomes Ohm's law for electrical conduction, Fick's law for diffusion, or Fourier's law for heat conduction.
EARTHSC	5687	Energy Geophysics	3	1121 and Math 1151 or above and Physics 1250 or above. (5661 for Petroleum Minor students )	Geophysical techniques related to energy applications, specifically oil and natural gas, gas hydrates, geothermal energy and carbon sequestration. Because another course addresses reflection seismology, this course focuses on geophysical well logging and address how to tie information between rock core, well logs and seismic.
CBE	5194* (5240**)	Petroleum Rock and Fluid Properties	3	EARTHSC 5661 and CBE 5194* (500** Intro to Petroleum Eng)	Thermodynamic behavior of naturally occurring hydrocarbon mixtures; evaluation and correlation of physical properties of petroleum reservoir fluids. Systematic theoretical and laboratory study of physical properties of petroleum reservoir rocks; lithology, porosity, elastic properties, strength, acoustic properties, electrical properties, relative and effective permeability, fluid saturations, capillary characteristics, and rock-fluid interaction.
CBE	5194* (5250**)	Enhanced Oil Recovery	3	EARTHSC 5661 and CBE 5194* (500**)	Fundamentals and theory of enhanced oil recovery; polymer flooding, surfactant flooding, miscible gas flooding and steam flooding; application of fractional flow theory; strategies and displacement performance calculations.
CBE	5194* (5260**)	Petroleum Project Evaluation	3	EARTHSC 5661 and CBE 5194* (500**)	Economic analysis and investment decision methods in petroleum and mineral extraction industries; depletion, petroleum taxation regulations, and projects of the type found in the industry; mineral project evaluation case studies.
* temporary    **proposed permanent course number					

<b>Fiscal Unit/Academic Org</b>	Chem & Biomolecular Engr - D1425
<b>Administering College/Academic Group</b>	Engineering
<b>Co-administering College/Academic Group</b>	
<b>Semester Conversion Designation</b>	New Program/Plan
<b>Proposed Program/Plan Name</b>	Petroleum Engineering Minor
<b>Type of Program/Plan</b>	Undergraduate minor
<b>Program/Plan Code Abbreviation</b>	PETE
<b>Proposed Degree Title</b>	

### Credit Hour Explanation

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program				15	
Required credit hours offered by the unit	Minimum			9	
	Maximum			12	
Required credit hours offered outside of the unit	Minimum			3	
	Maximum			6	
Required prerequisite credit hours not included above	Minimum			0	
	Maximum			7	

### Program Learning Goals

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

#### **Program Learning Goals**

- Expose students to the main petroleum engineering subjects, especially for the upstream sector.
- Equip students with an understanding of the vocabulary and engineering fundamentals needed to succeed in the oil & gas industry
- Increase their involvement in the petroleum industry, and build knowledge about the current practices and issues related to the petroleum industry.

### Assessment

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

**Is this a degree program (undergraduate, graduate, or professional) or major proposal? No**

### Program Specializations/Sub-Plans

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

## Pre-Major

Does this Program have a Pre-Major? No

## Attachments

- PETE\_Minor\_CCAA\_Approval.pdf: Letter  
*(Letter from the College to OAA. Owner: Quinzon-Bonello, Rosario)*
- Petroleum\_Eng\_Minor\_Proposal\_Final.docx: Proposal  
*(Program Proposal. Owner: Quinzon-Bonello, Rosario)*
- PETE\_Minor\_Earth\_Sciences\_Concur.pdf: Letter  
*(Support/Concurrence Letters. Owner: Quinzon-Bonello, Rosario)*

## Comments

## Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Quinzon-Bonello, Rosario	05/18/2017 10:21 AM	Submitted for Approval
Approved	Quinzon-Bonello, Rosario	05/18/2017 10:22 AM	Unit Approval
Approved	Quinzon-Bonello, Rosario	05/18/2017 10:23 AM	College Approval
Approved	Vankeerbergen, Bernadette Chantal	05/18/2017 03:09 PM	ASCCAO Approval
Approved	Fink, Steven Scott	05/18/2017 03:17 PM	ASC Approval
Pending Approval	Johnson, Jay Vinton Reed, Kathryn Marie	05/18/2017 03:17 PM	CAA Approval