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FORMAT 1

Submit original with signatures + 1 copy + electronic copy to Faculty Senate (Box 7500).  
See <http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures/> for a complete description of the rules governing curriculum & course changes.

NEW COURSE PROPOSAL

SUBMITTED BY:

Department	Petroleum Engineering (PETE)	College/School	CEM
Prepared by	Abhijit Dandekar	Phone	6427
Email Contact	adandekar@alaska.edu	Faculty Contact	Abhijit Dandekar

1. ACTION DESIRED (CHECK ONE): Trial Course ☐ New Course ☒

2. COURSE IDENTIFICATION: Dept PETE Course # 608 No. of Credits 3

Justify upper/lower division status & number of credits:

Graduate course

3. PROPOSED COURSE TITLE: Flow Assurance in the Petroleum Industry

4. To be CROSS LISTED? YES/NO No If yes, Dept: N/A Course # N/A  
(Requires approval of both departments and deans involved. Add lines at end of form for such signatures.)

5. To be STACKED? YES/NO No If yes, Dept: N/A Course # N/A

6. FREQUENCY OF OFFERING: As demand warrants (like all other cataloged PETE courses).  
Fall, Spring, Summer (Every, or Even-numbered Years, or Odd-numbered Years) - or As Demand Warrants

7. SEMESTER & YEAR OF FIRST OFFERING (AY2011-12 if approved by 3/1/2012; otherwise AY2012-13)  
Fall 2009 (AY 2009-2010)  
Fall 2012

8. COURSE FORMAT:

NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

COURSE FORMAT: (check all that apply) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☒ 6 weeks to full semester

OTHER FORMAT N/A

(specify)

Mode of delivery (specify lecture, field trips, labs, etc)  
Lecture

9. CONTACT HOURS PER WEEK: 3 LECTURE hours/weeks ☐ LAB hours/week ☐ PRACTICUM hours/week

Note: # of credits are based on contact hours. 800 minutes of lecture=1 credit. 2400 minutes of lab in a science course=1 credit. 1600 minutes in non-science lab=1 credit. 2400-4800 minutes of practicum=1 credit. 2400-8000 minutes of internship=1 credit. This must match with the syllabus. See <http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-guidelines-for-computing/> for more information on number of credits.

OTHER HOURS (specify type) N/A

10. **COMPLETE CATALOG DESCRIPTION** including dept., number, title, credits, credit distribution, cross-listings and/or stacking (50 words or less if possible):

PETE 6XX Flow Assurance in the Petroleum Industry (3 credits)

Study of the thermodynamics of gas hydrates; paraffin waxes; asphaltenes; scale and chemistry of corrosion and erosion processes. Study of chemical and physical methods used for mitigation of solid phase formation. Experimental analysis and modeling of solid phase formation envelopes. Analysis of flow regimes resulting from the presence of solid phases in oil and gas flow lines.

11. **COURSE CLASSIFICATIONS:** Undergraduate courses only. Consult with CLA Curriculum Council to apply S or H classification appropriately; otherwise leave fields blank.

H = Humanities  S = Social Sciences

Will this course be used to fulfill a requirement for the baccalaureate core? If YES, attach form.

YES:  NO:

IF YES, check which core requirements it could be used to fulfill:

O = Oral Intensive,   
Format 6

W = Writing Intensive,   
Format 7

Natural Science,   
Format 8

12. **COURSE REPEATABILITY:**

Is this course repeatable for credit?

YES

NO

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).

How many times may the course be repeated for credit?

TIMES

If the course can be repeated for credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

13. **GRADING SYSTEM:** Specify only one. Note: Later changing the grading system for a course constitutes a Major Course Change.

LETTER: ☒

PASS/FAIL: ☐

**RESTRICTIONS ON ENROLLMENT (if any)**

14. **PREREQUISITES**

These will be required before the student is allowed to enroll in the course.

15. **SPECIAL RESTRICTIONS, CONDITIONS**

16. **PROPOSED COURSE FEES**

Has a memo been submitted through your dean to the Provost for fee approval?

Yes/No

17. **PREVIOUS HISTORY**

Has the course been offered as special topics or trial course previously?

Yes/No

If yes, give semester, year, course #, etc.:

**18. ESTIMATED IMPACT**

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

Existing classrooms will be used. Current faculty (Abhijit Dandekar) will teach the entire course. There are no impacts.

**19. LIBRARY COLLECTIONS**

Have you contacted the library collection development officer (kljensen@alaska.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.

No

X

Yes

I do not see the need to contact the library because UAF library already has a subscription for [www.onepetro.org](http://www.onepetro.org), which is a large online collection of petroleum engineering literature from various societies. I have already used this extensively in the two previous offerings and moreover, the students that took the course also used this extensively. This is more than adequate for the required literature for the course. In addition to this I have a set of my own PPT slides that I upload on BB for instruction.

**20. IMPACTS ON PROGRAMS/DEPTS**

What programs/departments will be affected by this proposed action?

Include information on the Programs/Departments contacted (e.g., email, memo)

Departments/programs likely to be positively impacted are Civil and Mechanical engineering because this course primarily deals with fluid flow processes mainly in pipelines carrying petroleum reservoir fluids, i.e., oil, gas and water and thermodynamics.

**21. POSITIVE AND NEGATIVE IMPACTS**

Please specify positive and negative impacts on other courses, programs and departments resulting from the proposed action.

The proposed action has no negative impacts. It in fact has significant positive impacts in that our graduate students will be better prepared to tackle the current and future challenges faced by the petroleum industry as it shifts towards harsher (Alaskan arctic, deepwater, and hyperbaric reservoirs) hydrocarbon producing environments in which flow assurance assumes the utmost importance.

The proposed action will also be beneficial to our undergraduate students as they can take this course as technical or engineering elective.

As mentioned in item 20, considering the topic of the proposed course and the required pre-requisites, graduate and undergraduate (as an elective) students from civil as well as mechanical engineering departments can also take the proposed course, which will certainly widen their employability in the petroleum industry.

**JUSTIFICATION FOR ACTION REQUESTED**

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed course.

Flow assurance is a term coined by Petrobras in the early 1990's that signifies "guarantee of fluid flow" generally in the upstream and midstream sectors of the petroleum industry. Flow assurance is an issue on a pore scale in the reservoir and the near well bore region; the production tubing; surface facilities and long distance pipelines that transport gases and oils. With dwindling conventional easy to 'produce and flow' light oil resources, flow assurance is becoming increasingly important because of maturing oil fields and petroleum industry's paradigm shift towards exploitation of unconventional oil and gas resources such as hydrates and heavy oils in harsh arctic and ultra deepwater environments.

The solid phases that generally impact or hinder flow assurance in the petroleum industry are 1) gas hydrates; 2) paraffin waxes; 3) asphaltenes; 4) diamondoids; 5) scale; 6) corrosion and 7) erosion. These unwanted phases generally form at a wide range of pressure, temperature and compositional conditions. The blockages caused by these solid phases are expensive because they interrupt production and lead to costly remedial operations to clear lines. Flow assurance has become one of the central topics covering the

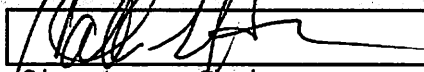
choice of a given field architecture and the specification of its production process and hence, flow assurance must take on a new perspective and focus. Therefore, flow assurance is the need of the hour of the petroleum industry; thus it is crucial that future petroleum engineering graduate students gain specific expertise in this area for the overall benefit of the petroleum industry. Herein lies the purpose of proposing this new course so that we produce a work force ready to face the industry's newer challenges.

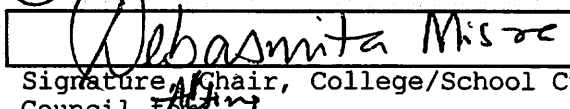
Since this course primarily entails fluid flow processes and thermodynamics it will be equally suitable and valuable for civil as well as mechanical engineering graduate students, and undergraduate students who can take this course as their engineering or technical elective.

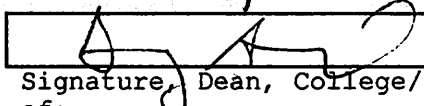
The proposed course does not lower the quality of UAF education in anyway. As a matter of fact it rather elevates the quality of UAF education because clearly the objective is to be proactive in producing students who will be adequately trained to face petroleum industry's challenges. Moreover, this type of course or even anything close has never been offered by petroleum engineering department and to the best of my knowledge that is also the case with other petroleum engineering programs in the nation.

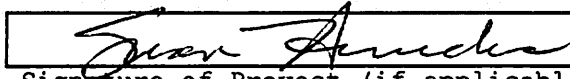
Finally, this course has been successfully offered twice in two previous fall semesters and had high enrollments of 10 and 14 respectively and was certainly well received and appreciated by the students.

**APPROVALS:** Add additional signature lines as needed.

 Date 9/20/11  
Signature, Chair,  
Program/Department of: \_\_\_\_\_

 Date 9/30/11  
Signature, Chair, College/School Curriculum  
Council for: CEM

 Date 10/3/11  
Signature, Dean, College/School  
of: CEM

 Date 10/6/11  
Signature of Provost (if applicable)  
Offerings above the level of approved programs must be approved in advance by the Provost.

**ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE**

\_\_\_\_\_  
Signature, Chair  
Faculty Senate Review Committee: \_\_\_Curriculum Review \_\_\_GAAC  
\_\_\_Core Review \_\_\_SADAC

## **PETROLEUM ENGINEERING DEPARTMENT**

### **PETE 608: Flow Assurance in the Petroleum Industry**

Semester: XXX  
Credits: 3  
Class Meetings: 3 hours of lecture per week (day TBD); 6-9pm proposed given our Anchorage based students  
Room: DUCK 344 (proposed, since this is VC equipped so the course is also delivered to our graduate students located in Anchorage)  
Instructor: Professor Abhijit Y. Dandekar, Ph.D.  
Office: DUCK 415  
Contact information: (907) 474-6427; Fax: (907) 474-5912; [adandekar@alaska.edu](mailto:adandekar@alaska.edu)  
Office hours: 9-11am following the day of course offering

#### **PROPOSED CATALOG DESCRIPTION**

Study of the thermodynamics of gas hydrates; paraffin waxes; asphaltenes; scale and chemistry of corrosion and erosion processes. Study of chemical and physical methods used for mitigation of solid phase formation. Experimental analysis and modeling of solid phase formation envelopes. Analysis of flow regimes resulting from the presence of solid phases in oil and gas flow lines.

#### **PRE-REQUISITES**

Permission of instructor.

#### **COURSE READINGS/MATERIALS**

- Instructor will provide PPT slides, which will be uploaded on BB
- Additionally, other literature materials such as SPE papers, various web resources, technical reports etc. will be extensively used throughout the course duration. All these are readily available on [www.onepetro.org](http://www.onepetro.org) and other online resources of UAF library.

#### **COURSE GOALS**

Provide students with broad knowledge of the advanced principles of petroleum engineering and their application to global challenges that include the industry's paradigm shift toward technically challenged oil and gas resources (heavy oils, gas hydrates etc.), which naturally lead to flow assurance issues. This course thus imparts the students with the skills necessary to confidently deal with flow assurance issues taking into account, safety, environmental, and societal impacts. This is of particular importance to Alaska as TAPS continues to age and will increasingly transport heavy oils in the future that are problematic from flow standpoint.

#### **STUDENT LEARNING OUTCOMES**

- Students will have a better understanding of what the various organic solids, i.e., gas hydrates, asphaltenes, and waxes are and how they damage or affect the operability of hydrocarbon production and transportation infrastructure.
- Students will be able identify the T&P and compositional conditions at which the various solids form in the reservoir-production tubing-offshore and other flowlines-separators-pipelines network, so that they can better manage the flow assurance issues.
- Students will be able to identify the role of various inhibitors in mitigation of solids and determine the concentration required to prevent the occurrence of solids.

## INSTRUCTIONAL METHODS

The class will consist of 3 hour lecture per week, which will also include in-class exercises, demonstration of flow assurance spreadsheet based calculations and discussion of case studies.

## GRADING POLICY

Grades will depend on the following:

- Take home mid-term examination (100 points)
- Take home final examination (100 points)
- 5 homework assignments (10 points each)
- Final project (presentation and report is mandatory) will be based on the design of flow assurance strategies for a given case (100 points; 70 for report and 30 for presentation)

Letter grade cut-offs are shown below. Final percentage will be computed on the basis of total points earned by each student to assign a grade. For example if a student earns 350 points, this will result in 100% and A+ grade will be awarded. If a student earns 210 points, this will result in 60% and thus a C- grade will be awarded.

A+ (100%); A (99.99-95%); A- (94.99-90%); B+ (89.99-85%); B (84.99-80%); B- (79.99-75%); C+ (74.99-70%); C (69.99-65%); C- (64.99-60%)

## COURSE CALENDAR

Week	Topic
1	Introduction to flow assurance
2	Flow regimes in reservoirs; production tubing; deepwater umbilicals; surface facilities; oil and gas pipelines with and without the presence of solid phases
3 & 4	Thermodynamics of gas hydrates; paraffin waxes; asphaltenes; diamondoids and scale deposition
5 & 6	Experimental techniques for determination of solid phase formations – hydrate phase behavior; WAT/WDT; cloud points; pour points; asphaltene stability tests etc.
7	Application of EOS models/PVTSIM for prediction of solid phase formation conditions
8	Mechanical methods to remove solid phases– pigging; scraping etc.
9	Chemical methods to remove solid phases – inhibitor treatment; pour point depressants; asphaltene inhibitors; diluent additions; acid treatments etc.
10	Case studies of asphaltenic and waxy oils; hydrate flow assurance issues in pipelines; scale and corrosion
11	Flow assurance issues with particular emphasis on arctic and deepwater environments
12 & 13	Excel spreadsheet based calculations pertinent to flow assurance
14	Student final project presentations

### COURSE POLICIES

Attendance in class is your responsibility. Students are responsible for making up any missed work (lectures and homeworks). Students are encouraged to arrive to class on time. Make-up examinations will be held only under exceptional circumstances (e.g. illness, family crises, etc.). Medical documentation will be required to confirm illnesses. I follow the university guidelines for plagiarism/academic integrity as outlined in the current UAF catalog.

### DISABILITY SERVICES

The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. I will work with the Office of Disabilities Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities.