CALIFORNIA STATE UNIVERSITY, BAKERSFIELD
ACADEMIC SENATE

NEW EMPHASIS:
BIOSYSTEMS AND AGRICULTURAL ENGINEERING

RES 1213032

AAC/BPC

RESOLVED: that the Academic Senate approves the proposed emphasis in Biosystems and Agricultural Engineering within the BS in Engineering Sciences.

RATIONALE: The Budget and Planning Committee has reviewed the proposal and finds it fiscally responsible. The Academic Affairs Committee has reviewed the proposal and found that all curricular matters have been appropriately addressed.

Distribution List:
President Horace Mitchell
Provost Soraya Coley
AVP Undergraduate Studies Carl Kemnitz
NMSE Dean Julio Blanco
Chair Jorge Talamantes

Approved by the Academic Senate on June 6, 2013
Sent to the President for approval in June 17, 2013
Approved by the President on June 19, 2013

RECEIVED
Academic Programs
APR 0 4 2013

RECEIVED
APR 0 4 2013

PROPOSAL FOR A NEW MINOR, CONCENTRATION or EMPHASIS

CSU Bakersfield
School of Natural Sciences,
Mathematics, and Engineering

Proposals to add a new minor, concentration or emphasis must receive appropriate campus approval prior to implementation. In addition, the Chancellor's Office must be notified of the campus approval prior to implementation. All attachments are to be added to this cover sheet and remain with the proposal through the required steps of evaluation. Please consult with the Associate Vice President of Academic Programs for questions or assistance.

This new proposal is a (check one):

☐ Minor - Is this minor available to all undergraduate students? ☐ Yes ☐ No, only in _____

☐ Concentration ☑ Emphasis within the degree of Engineering Sciences

Title Biological and agricultural Engineering
Petroleum Engineering effective (term): Fall 2013

☐ Use the following degree code _____ instead of the major degree code for reporting (note the necessary criteria and degree codes)

Originating Department or Individual: Physics and Engineering

If a department formally approved the attached proposal, attach the appropriate memorandum and approval date.

Signature: _____ date: 3/13/2013

Curriculum Committee(s): Interschool programs should attach comments or approval from relevant school or department curriculum committees before being submitted to the Academic Affairs Committee, acting as the University Curriculum Committee. A memorandum and approval date from the curriculum committee must be attached. If any revisions were required or agreed to, a revised copy of the proposal must be attached.

Chair Signature: _____ date: 3/13/13

School Dean(s): I have reviewed this proposal and send it forward for university-wide review with my comments attached. These comments include my analysis of the resource commitments that must be made to support the program and the origin(s) of those resources.

Dean Signature: _____ date: 4/4/13

AVP of Academic Programs: I have reviewed this proposal and send it forward to the Provost.

AVP Signature: _____ date: 4/8/13

Date of Senate Approval: _____ **Date of President Approval**: _____

Please attach the final Academic Senate Resolution, as signed by the President and return to the Office of Academic Programs, which will notify the Chancellor's Office and the appropriate campus departments. A copy of this form and final electronic catalog copy must be sent to the Director of Academic Operations and Support.

CSU Bakersfield
School of Natural Sciences, Mathematics, and Engineering
Department of Physics and Engineering

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www.csub.edu/nsme

To: Dr. Roy Lafever, Chair, NSME Curriculum Committee

From: Jorge Talamantes, Chair, Department of Physics and Engineering

Date: February 13, 2013

Re: Proposal for two new emphases within the B. S. in Engineering Sciences

The department has approved the attached proposal for a new Emphasis in Biosystems and Agricultural Engineering, and a new Emphasis in Petroleum Engineering. Both are optional emphases within the B. S. in Engineering Sciences.

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Proposal for two new emphases within the B. S. in Engineering Sciences

Table of Contents

Introduction. We presently offer a B. S. in Engineering Sciences with an optional Engineering Management Emphasis. The development of this program and the associated facilities is being funded primarily by a $4.3M five-year grant from the US Department of Education. The project is entitled "Developing New Engineering Degree Options for Underserved Hispanic Students in the Southern San Joaquin Valley." In addition, we have a $295K two-year grant from the US Department of Agriculture (USDA) for a project entitled "Broadening Access to Modern STEAM Education in the High Needs Southern San Joaquin Valley", and we are a sub-awardee on a five-year Bakersfield College US Department of Education grant for a project entitled "Turning a Gateway into a Pathway to STEM Degrees for Hispanic and Low-Income Students in the Southern San Joaquin Valley." Our part amounts to $1.1M over the grant period. This adds up to $5.7M over the five year period ending with AY 2015-2016. We are presently writing more grant proposals to the USDA to further support our engineering programs.

The Engineering Sciences program was approved last year, and it opened in Fall 2012. As mentioned above, that program offers an optional Engineering Management Emphasis (which we developed together with the School of Business and Public Administration.) The plan to fulfill the goals and objectives of our US Department of Education grant has always been to address the needs of our students and local industry by adding new optional emphases to our B. S. in Engineering Sciences. We did not propose other emphases together with our initial curriculum proposal because we wanted to wait until we hired engineers into the department so we could benefit from their input. We hired two new engineering faculty this past fall. Thus, we have developed this proposal for two new optional emphases: one in Petroleum Engineering, and one in Biosystems and Agricultural Engineering.

It is very important to point out that we are not requesting any new resources from the university. This proposal will be implemented fully using funds from the above-mentioned external grants. Indeed, this curriculum proposal is a continuation of our Engineering Sciences proposal that was approved in April 2012 by Chancellor Reed.

Proposal

1) **Program Identification**

a) *Full and exact degree designation and title:* Bachelor of Science with a Major in Engineering Sciences and an Emphasis in Petroleum Engineering; Bachelor of Science with a Major in Engineering Sciences and an Emphasis in Biosystems and Agricultural Engineering.

b) *Term and academic year of intended implementation:* Fall 2013 (both emphases).

c) *Total number of units required for graduation*: 180 units (both emphases).

d) *How this emphasis will support the campus mission and will not impede the successful operation and growth of existing academic programs.*

The two emphases are being proposed in response to high demand in the region for engineers with expertise in biosystems and agricultural, and petroleum engineering. In this way, the new emphases will support the economic development of the region, as well as advancing the opportunities available to students interested in these fields. The emphases will involve structuring new elective courses within the Engineering Sciences program. The new electives will be taught largely by adjunct faculty from our area, and will be fully funded initially from our grants. Eventually, these emphases will be self-supporting, and will not adversely affect existing academic programs by diverting resources needed elsewhere. At the same time, the emphases will provide our students access to a robust engineering education in fields that especially marketable in the Southern San Joaquin Valley. Nevertheless, the skills provided by our curricula will enable our graduates to find engineering employment anywhere.

e) If students must apply directly to the concentration or emphasis (rather than the major), propose the Classification of Instructional Programs (CIP) Code and CSU Degree Program Code to be used.

N/A

2) **Program Overview and Rationale**

a) Rationale, including a brief description of the emphasis, its purpose and strengths, fit with institutional mission, and a justification for offering the emphasis at this time. The rationale may explain the relationship among the emphasis philosophy, design, target population, and any distinctive pedagogical methods.

As one of the top producers of fruits and vegetables globally, the San Joaquin Valley is often referred to as the "salad bowl of the world." For example, 80% of the carrots eaten in the United States are grown in the Valley. The valley faces a shortage of a well-educated, well-trained workforce capable of addressing the modern agriculture industry challenges including water management, research and development, food production quality and efficiency, and sustainability. There is no regional education pipeline to produce this workforce. There is enormous underdeveloped human capital in the area, and lack of access to high-quality degree programs that are responsive to the food and agricultural industry needs is a serious problem for the region and the nation as a whole. Production, new varieties of research and development, energy and water management, and food safety are all areas that require highly skilled professionals with a strong engineering background. With these serious problems threatening the future of agriculture in this highly productive region, CSUB has to take the initiative to establish a regional agricultural engineering pathway in the southern San Joaquin Valley.

The Biosystems and Agricultural Engineering Emphasis addresses local needs in terms of applications such as environmental, agricultural, and other bioprocesses work (not biotechnology). The proposed emphasis comprises a set of six elective courses (two of which are laboratory courses), totaling 23 units. Students in the Engineering Sciences major are already required to take 23 units of electives, and may choose to fulfill this requirement through these six courses. We developed this emphasis with the advice of faculty in Department of Biological and Agricultural Engineering at UC Davis. In addition, professionals from the local agricultural industry will provide a feedback on the degree program and they will also serve as an expertise source for some of the courses in this emphasis. The local industry is very supportive and enthusiastic in having a biosystems and agricultural engineering pathway at CSUB.

Many of the engineering sciences and pre-engineering students have expressed an interest in petroleum engineering. However, there are few universities that offer either a degree or a minor in petroleum engineering. Throughout the US, only 17 universities offer an undergraduate degree in petroleum engineering. In California, only Stanford University offers a B. S. in Petroleum Engineering (although it has been recently renamed Energy Resources Engineering); after that, the closest university is the New Mexico Institute of Mining and Technology, 800 miles to the east. Likewise, there are few universities that offer a minor or other program in petroleum engineering. Within California, only the University of Southern California (USC) offers a minor in petroleum engineering. California State University at San Luis Obispo does offer elective courses in petroleum engineering within the mechanical engineering undergraduate program, but it does not offer any structured formal program in petroleum engineering. Therefore, we are proposing the only formal Petroleum Engineering

program in a public university in the state. The reason we can do this is that CSUB is in a unique position to offer this program because of its proximity to huge petroleum resources. Indeed, Kern County has four of the top eleven oil fields in the country, and 81% of California's oil wells. This has brought much expertise associated with petroleum companies such as Chevron, Aera, etc. We will be able to avail of that industry expertise to implement our petroleum engineering emphasis.

In addition to student interest, there is a local industry need for petroleum engineers, particularly if they are native to the Bakersfield area. Leaders in the local oil industry are very worried about the predicted retirement of aging experts. The proposed petroleum engineering emphasis has been developed to address this local need, and has been specifically been developed to suit local requirements.

The proposed petroleum engineering emphasis is adapted from the USC program, and comprises a set of five elective courses totaling 23 units. Students in the engineering sciences major are already required to take 23 units of electives, and may choose to fulfill this requirement through these five courses. The five courses are designed to cover core topics that are necessary for practicing petroleum engineers. They were developed in coordination with a petroleum engineer working in the field in Bakersfield, who also teaches many of the petroleum engineering courses at USC.

The proposed emphasis in petroleum engineering would offer students an opportunity to pursue a formal program in petroleum engineering that is coordinated with the local petroleum industry. It can also offer to local industry a source of well-educated engineers who are ready for the petroleum field, and who are also native to the Bakersfield area.

b) *Complete catalog description, including program description, units required for degree, degree requirements, and admission requirements.*

Department Chair: Jorge Talamantes
Program Office: Science Building III, 307
Telephone: (661) 654-2664
email: engineering@csub.edu
Website: www.csub.edu/engineering
Faculty: D. Abouelnasr, L. Cabrales Arriaga, A. Dzyubenko, V. Gasparyan, J. Lewis, R. Negrini, T. Meyer, J. Talamantes

Program Description
Engineering Sciences is a broad-based general engineering degree program. As such, it provides the graduate flexibility, breadth of technical knowledge, and

communication skills so important in today's rapidly changing multidisciplinary and multicultural work environment. The student may opt for a BS in Engineering Sciences with an Emphasis on Biosystems and Agricultural Engineering, Engineering Management, or Petroleum Engineering by the appropriate choice of electives.

The Engineering Sciences program provides a curriculum and course of training that prepares the student not only for today's challenges, but also for future ones in a fast-paced, global, and diverse society. The program emphasizes the fundamentals of engineering and modern methods, processes and technologies, and also gives the students the tools to learn by themselves and to pursue life-long learning. Furthermore, the program and the faculty strive to ensure that graduates also attain a global understanding of the environmental, ethical and societal impacts of the technologies they help develop.

The program offers opportunities for team-based design projects in collaboration with local industries and public institutions, thus preparing students for careers in for-profit and non-profit organizations, or to further their education in graduate school. Faculty members of the Department of Physics and Engineering will be pleased to advise any students who may wish to pursue this major. For student learning objectives and more information, visit our website at www.csub.edu/engineering.

Requirements for the Bachelor of Science Degree in Engineering Sciences

Total Units Required to Graduate		**180 units**
Major Requirements		**123 units**
ENGR Courses	64	
Cognates	59	
Other University Requirements		**52-57 units**
CSUB 101	2	
American Institutions	5	
Area A1, A2	10*	
Area B2	0*, **	
Area C	15	
Area D	10***	
Theme 1	0*	
Theme 2	0****	
Theme 3	5	
GRE	5	
GWAR (Exam) or Class	0-5	

*A3, B1, B3, Theme 1 satisfied in major or cognate. **BIOL 103 is required for the major and satisfies the Area B2 requirement. ***Assumes PLSI 101 is taken to

double-count American Institutions and Area D3. ****PHIL 316 is required for the major and satisfies the Theme 2 requirement.

Major Requirements for the Bachelor of Science Degree in Engineering Sciences

1. **Lower Division** (17 units):
   ENGR 161, 207, 240, 244
2. **Upper Division Required** (24 units):
   ENGR 300, 310, 320, 330, 490A, 490B, 490C
3. **Upper Division Electives** (23 units):
   ENGR 307, 340, 341, 342, 351, 410, 420, 422, 424, 426, 440, 441, 442, 452, 453, 454, 477
4. **Cognate Requirements** (59 units):
   MATH 201, 202, 203, 204 or MATH 231, 232, 233, 234 and PHYS 221,222, 223, CHEM 211, CMPS 150, 221, BIOL 103, PHIL 316.

Major Requirements for the Bachelor of Science Degree in Engineering Sciences with Biosystems and Agricultural Engineering Emphasis

The Biosystems and Agricultural Emphasis is obtained by taking the courses required above for the BS degree in Engineering Sciences, but choosing the following 23 units of Upper Division electives:

1. ENGR 340, 341, 342, 440, 441, 442.
2. In addition, students pursuing this emphasis are encouraged to undertake a design project related to biosystems and agricultural engineering, when available, in ENGR 490 A, B and C.
3. Although not required for the emphasis, students are strongly advised to take ENGR 307 and 426.

Major Requirements for the Bachelor of Science Degree in Engineering Sciences with Engineering Management Emphasis

The Engineering Management Emphasis is obtained by taking the courses required above for the BS degree in Engineering Sciences, but choosing the following Upper Division electives:

1. ENGR 420, 422, 424, 426
2. An additional 7 units of electives that apply towards the BS in Engineering Sciences

Major Requirements for the Bachelor of Science Degree in Engineering Sciences with Petroleum Engineering Emphasis

The Petroleum Engineering Emphasis is obtained by taking the courses required above for the BS degree in Engineering Sciences, but choosing the following 23 units of Upper Division electives:

1. ENGR 351, 426, 452, 453, 454.
2. In addition, students pursuing this emphasis are encouraged to undertake a design project related to petroleum engineering, when available, in ENGR 490 A, B and C.

Information on General Education Courses

- CSUB 101 Roadrunner RUSH-A seminar is required for entering Freshman.
- Any of the required Physics courses (PHYS 221, 222,223) or CHEM 221 will satisfy Areas B1 and B3.
- Any of the required calculus courses (MATH 201, 202, 203, 204 or MATH 231, 232, 233, 234) will satisfy Area B4.
- Area A3 is substituted by ENGR 207 for Engineering Sciences
- PHIL 316 Professional Ethics must be taken and will satisfy Theme 2.

Course Descriptions

Lower Division

ENGR 161 Introduction to Engineering Design (2)
Introduces students to real-life engineering projects. Students design, build, tests and present engineering projects designed to solve specified problems within given constraints. Primarily for students planning to major in one of the fields of engineering. Two hours of lecture/discussion.

ENGR 207 Electric Circuits (5)
Circuit laws and analysis of DC and AC circuits. Physical properties, electrical characteristics and circuits of discrete and integrated electrical and electronic devices. Design and construction of circuits with instrumentation applications. Three hours lecture/discussion and two three-hour laboratories per week. Prerequisites: PHYS 222, MATH 202/222 or 232, MATH 222 or CMPS 221 (MATH 203 or 233 recommended).

ENGR 240 Analytic Mechanics, Statics (5)
Fundamental principles of force systems acting on particles and rigid bodies in static equilibrium. Applications to structural and mechanical problems, both two-dimensional and three-dimensional. Five hours lecture/discussion/ Prerequisites: PHYS 221, Co-requisite MATH 202.

ENGR 244 Properties of Materials (5)

Structure of matter. Physical and mechanical properties of materials including metals, polymers, ceramics, composites, and electronic materials. Equilibrium diagrams. Materials selection, corrosion phenomena. Heat treatment, cold deformation, brittle-ductile fracture behavior. Three hours lecture/discussion, two three-hour laboratories. Prerequisites: MATH 201, PHYS 221, and CHEM 211.

Upper Division

ENGR 300 Engineering Modeling and Analysis (5)
Formulation of mathematical models for engineering systems; applying mass, momentum, and energy balances to derive governing differential equations; solution of differential equations and eigenvalue problems typically encountered within an engineering context; solving equations with the use of spreadsheets and other numerical computing environments such as MATLAB; fitting linear and nonlinear models to experimental data; concepts in probability and statistics. Four hours lecture/discussion and one three-hour laboratory per week. Prerequisites: PHYS 222, CMPS 221.

ENGR 307 Principles of Electronics (5)
Circuit laws, theorems, equivalent circuits. Physical properties, electrical characteristics and circuits of electrical and electronic devices, discrete and integrated. Design and construction of analog and digital circuits with instrumentation applications. Three hours lecture/discussion and two three-hour laboratories per week. Prerequisites: ENGR 207 and PHYS 223 (MATH 205 recommended).

ENGR 310 Thermodynamics (4)
Properties of working fluids and fundamental relations for processes involving the transfer of energy. First and second laws of thermodynamics, irreversibility and availability. Four hour lecture/discussion per week. Prerequisites: PHYS 222.

ENGR 320 Fluid Mechanics (5)
Hydrostatics and fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, laminar and turbulent flow, compressible flow. Experiments involving flow measurement and control, conservation equations, pressure and velocity distributions, dimension analysis for lift and drag. Four hours lecture/discussion, one three hour laboratory. Prerequisite: ENGR 300

ENGR 330 Heat Transfer (4)
Introduces the analysis of steady and transient heat conduction, forced and natural convection, radiation heat transfer, and design of heat exchangers. Analytical and numerical methods in heat transfer and fluid mechanics. Topics include heat conduction and convection, gaseous radiation, boiling and

condensation, general aspects of phase change, mass transfer principles, multimode heat transfer and the simulation of thermal fields, and the heat transfer process. Four hours lecture/discussion per week. Prerequisites: ENGR 310, 320.

ENGR 340 Soil and Water Resource Management (4)
Soil and water management systems and practices including hydrology, surface drainage, open channels, and erosion, subsurface drainage, impoundments and irrigation. Four hours lecture/discussion per week. Prerequisites: ENGR 240. Perequisite of corequisite: ENGR 300 or consent of instructor.

ENGR 341 Engineering Principles of Agricultural Machines (3)
Application of machine systems to agricultural production and biological processing. Functional design and analysis of equipment. This course is designed to provide a broad foundation for understanding machine system. Machine systems are an integral part of many agricultural operations from field production to post-harvest processing, storage, transportation, and bio-based processing. Three hours lecture/discussion per week. Prerequisites: ENGR 240 or consent of the instructor.

ENGR 342 Bioprocess engineering (4)
Engineering principles, processes and techniques for using biological agents such as cells, enzymes or antibodies for the production of chemicals, food, biofuels and pharmaceuticals, and waste treatment. The course includes stoichiometry and kinetics of reactions that employ biological agents; design, analysis and operation of reactors; and product recovery and purification.Four hours lecture/discussion per week. Prerequisites: ENGR 240 and CHEM 211 or consent of the instructor.

ENGR 351 Fundamentals and Transport in Petroleum Engineering (5)
Introduction to fundamental concepts in petroleum engineering. Topics include the origin, migration and accumulation of petroleum, properties of reservoir rocks and fluids. Introduces petroleum exploration, reservoir engineering, drilling technology, well completion, and production engineering. Five hours lecture/discussion per week. Prerequisites: CHEM 211, PHYS 221, and MATH 202 or 232, or consent of the instructor.

ENGR 410 Power Systems Analysis (4)
Fundamentals, power transformers, transmission lines, power flow, fault calculations, power system controls. Unbalanced networks, symmetric and unsymmetrical faults, transient transmission line modeling, system protection. Four hours lecture/discussion per week. Prerequisite: ENGR 207.

ENGR 420 Operations Research (4)

Introduction to deterministic optimization modeling and algorithms in operations research. Emphasis on formulation and solution of linear programs, networks flows, and integer programs. Introduction to probabilistic models in operations research. Emphasis on Markov chains, Poisson processes, and their application to queueing systems. Four hours lecture/discussion per week. Prerequisites: ENGR 300.

ENGR 422 Project Management (4)
Projects are unique, strategically important, complex endeavors with definite beginning and ending dates. The course develops the skills required to manage the component processes of a project throughout its life cycle: scope, time and sequencing, cost, quality, human resources, communications, risk, procurement, and project integration management. The project life cycle encompasses development of the initiative out of strategic planning activities, articulation of project goals and objectives, planning project components and their integration, execution and control, project close out, and follow-up activities. Four hours lecture/discussion per week. Prerequisites: Senior standing in Engineering Sciences.

ENGR 424 Quality Management (4)
An overview of management literature relating to quality planning, quality control, quality assurance, and quality improvement. A consideration of the core principles and methods common to most quality improvement programs and their relationship to management principles. Comparison of prevalent quality improvement programs such as ISO9004: 2008, SixSigma, and TQM and the Malcolm Baldrige Standards. Case studies. Four hours lecture/discussion per week. Prerequisites: Senior standing in Engineering Sciences.

ENGR 426 Economics of Engineering Design (4)
Cost measurement and control in engineering studies. Basic accounting concepts, income measurement, and valuation problems. Manufacturing cost control and standard cost systems. Capital investment, engineering alternatives, and equipment replacement studies. Four hours lecture/discussion per week. Prerequisites: ENGR 300.

ENGR 440 Biological Systems Applications (4)
Principles of heat and mass transfer in the context of biological (biomedical/bioprocessing/bioenvironmental) systems. Physical understanding of transport processes and simple reaction rates with application to examples from plant, animal, and human biology. Four hours lecture/discussion per week. Prerequisite or corequisite: ENGR 320 or consent of the instructor.

ENGR 441 Environmental Engineering (4)
An introduction to environmental engineering, including: water usage and conservation; water chemistry including pH and alkalinity relationships, solubility and phase equilibria; environmental biology; fate and transport of contaminants in lakes, streams and groundwater; design and analysis of mechanical, physicochemical and biochemical water and wastewater treatment processes.Three hours lecture/discussion and one three hour laboratory per week. Prerequisites or corequisite: ENGR 320 or consent of the instructor.

ENGR 442 Food and Bioprocess Engineering Unit Operations (4)
Principles of the engineering design, testing and analysis of unit processing operations employed in the food and bioprocess industries, such as sterilization, pasteurization, freezing/refrigeration, drying, evaporation, and fermentation, along with physical, chemical and phase separations. Design and analysis of thermal, freezing, evaporation, dehydration; and mechanical, chemical and phase separations processes as governed by reaction kinetics and rheology of food and biological materials. Three hours lecture/discussion and one three hour laboratory per week. Prerequisites: ENGR 330 or consent of the instructor.

ENGR 452 Petroleum Production Engineering (4)
Covers topics in modern petroleum production engineering, including production technologies, production equipment, equipment design and optimization, well completion, tubing design, well performance evaluation (productivity index), inflow performance relationships (IPR), artificial lift and surface facilities. Four hours lecture/discussion per week. Preprequisite: ENGR 351 or consent of the instructor.

ENGR 453 Reservoir Engineering (5)
Fundamental equations of fluid flow through porous media, reservoir material balances, aquifer influx, well testing, and decline curve analysis. Methods for forecasting reservoir performance are covered using analytical models. Five hours lecture/discussion per week. Preprequisites: MATH 203 or 233, and ENGR 351, or consent of the instructor.

ENGR 454 Drilling Engineering and Completion Technology (5)
Fundamentals of drilling equipment, engineering design calculations, wellbore diagrams, drilling fluids, cement calculations, and casing design. Additional topics such as directional drilling as well as completion technologies are covered using practical examples and field applications as applied in the oil and natural gas well drilling operations. Four hours lecture/discussion and one three-hour laboratory per week. Prerequisites: ENGR 244, and 351, or consent of the instructor.

ENGR 477 Special Topics in Engineering Sciences (1-4)
This course will often be used to supplement other courses with additional work at a more advanced level. May be repeated in different topics. Prerequisite: permission of instructor.

ENGR 490A Senior Seminar A (2)
Selection and initiation of an engineering design project under faculty supervision. Collaborative projects with local industry partners are encouraged. Projects are presented in a formal report and in a formal presentation. Two hours lecture/discussion per week. Prerequisite: Open only to senior Engineering Sciences majors.

ENGR 490B Senior Seminar B (2)
Project under faculty supervision. Collaborative projects with local industry partners are encouraged. Projects are presented in a formal report and in a formal presentation. This course is a continuation of ENGR 490A. Two hours lecture/discussion per week. Prerequisite: Open only to senior Engineering Sciences majors, ENGR 490A.

ENGR 490C Senior Seminar C (2)
Completion of a project under faculty supervision. Collaborative projects with local industry partners are encouraged. Projects are presented in a formal report and in a formal presentation. This course is a continuation of ENGR 490B. Two hours lecture/discussion per week. Prerequisite: Open only to senior Engineering Sciences majors, ENGR 490B.

3) **Curriculum**

a) Goals for the (1) program and (2) student learning outcomes. Program goals are very broad statements about what the program is intended to achieve, including what kinds of graduates will be produced. Student learning outcomes are more specific statements that are related to the program goals but that more narrowly identify what students will know and be able to do upon successful completion of the program.

The Biosystems and Agricultural Engineering Emphasis, as well as the Petroleum Engineering Emphasis will be integrated with the BS in Engineering Sciences program, and so will share the same goals (educational objectives) and will support the program student learning outcomes.

The program educational objectives are to produce graduates who, during the first few years of professional practice, will:

- Be employed by industry or government in fields such as design, research and development, experimentation and testing, manufacturing, and technical sales.
- Assume an increasing level of responsibility and leadership within their respective organizations.
- Communicate effectively and work collaboratively in multidisciplinary and multicultural work environments.
- Recognize and understand the global, environmental, social, and ethical contexts of their work.
- Be flexible in responding to changing social and technical environments.
- Be academically prepared to pursue graduate studies and/or certificate programs in a field of engineering.
- Be committed to lifelong learning to enhance their careers.

Student outcomes for the Engineering Sciences program are, upon graduation, a graduate in engineering science should demonstrate:

- An ability to apply knowledge of mathematics, science and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- An ability to function in multidisciplinary teams.
- An ability to identify, formulate, and solve engineering problems.
- An understanding of ethical and professional responsibility.
- An ability to communicate effectively.
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- A recognition of the need for, and an ability to engage in life-long learning.
- A knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

b) *Plans for assessing program goals and student learning outcomes. Some planners find it helpful to develop matrices in which student learning outcomes and required courses are mapped, indicating where content related to the learning outcomes is introduced, reinforced, and practiced at an advanced level in required courses.*

The two emphases will be assessed as a part of the assessment of the engineering sciences program. The current assessment plan for the engineering

sciences program is in appendix A. Additional assessment will involve surveys of graduating students, alumni, and their employers.

c) *Other concentrations or emphases and how their curriculum overlaps that proposed*

There are no elective courses shared between the two new proposed emphases.

One other emphasis is currently available in the Engineering Sciences program, the Engineering Management Emphasis. That emphasis requires 16 units of elective courses, which may be counted towards the required 23 units of electives for the program. Of these 16 units, one course is common with the proposed Petroleum Engineering emphasis, ENGR 426 Economics of Engineering Design (4 units).

d) *A list of all courses required for the program, specifying catalog number, title, units of credit, and prerequisites or co-requisites (ensuring that there are no "hidden" prerequisites that would drive the total units required to graduate beyond the total reported in 4c above). Include proposed catalog descriptions of all new courses.*

The Biosystems and Agricultural Engineering Emphasis is obtained by taking the courses required above for the BS degree in Engineering Sciences, but choosing the following 23 units of Upper Division electives. All listed prerequisites are required for the Engineering Science program, i.e. there are no hidden prerequisites.

- ENGR 340 Soil and Water Resource Management (4). Prerequisite: ENGR 240. Perequisite of corequisite: ENGR 300 or consent of instructor. (Note: This is not a new course.)
- ENGR 341 Engineering Principles of Agricultural Machines (3). Application of machine systems to agricultural production and biological processing. Functional design and analysis of equipment. This course is designed to provide a broad foundation for understanding machine system. Machine systems are an integral part of many agricultural operations from field production to post-harvest processing, storage, transportation, and bio-based processing. Three hours lecture/discussion per week. Prerequisites: ENGR 240 or consent of the instructor.
- ENGR 342 Bioprocess engineering (4). Engineering principles, processes and techniques for using biological agents such as cells, enzymes or antibodies for the production of chemicals, food, biofuels and pharmaceuticals, and waste treatment. The course includes stoichiometry and kinetics of reactions that employ biological agents; design, analysis and operation of reactors; and product recovery and purification.Four hours lecture/discussion per week. Prerequisites: ENGR 240 and CHEM 211 or consent of the instructor.

- ENGR 440 Biological Systems Applications (4). Prerequisite or corequisite ENGR 320 or consent of the instructor. (Note: This is not a new course.)
- ENGR 441 Environmental Engineering (4). An introduction to environmental engineering, including: water usage and conservation; water chemistry including pH and alkalinity relationships, solubility and phase equilibria; environmental biology; fate and transport of contaminants in lakes, streams and groundwater; design and analysis of mechanical, physicochemical and biochemical water and wastewater treatment processes. Three hours lecture/discussion and one three hour laboratory per week. Prerequisite or corequisite ENGR 320 or consent of the instructor.
- ENGR 442 Food and Bioprocess Engineering Unit Operations (4). Principles of the engineering design, testing and analysis of unit processing operations employed in the food and bioprocess industries, such as sterilization, pasteurization, freezing/refrigeration, drying, evaporation, and fermentation, along with physical, chemical and phase separations. Design and analysis of thermal, freezing, evaporation, dehydration; and mechanical, chemical and phase separations processes as governed by reaction kinetics and rheology of food and biological materials. Three hours lecture/discussion and one three hour laboratory per week. Prerequisites: ENGR 330 or consent of the instructor.

Courses required for the Petroleum Engineering Emphasis are listed below with prerequisites. All listed prerequisites are either required for the Engineering Science program, or are already required for the Petroleum Engineering Emphasis.

- ENGR 351 Fundamentals and Transport in Petroleum Engineering (5). Introduction to fundamental concepts in petroleum engineering. Topics include the origin, migration and accumulation of petroleum, properties of reservoir rocks and fluids. Introduces petroleum exploration, reservoir engineering, drilling technology, well completion, and production engineering. Five hours lecture/discussion per week. Prerequisites: CHEM 211, PHYS 221, and MATH 202 or 232 or consent of the instructor.
- ENGR 426 Economics of Engineering Design (4). Prerequisite: ENGR 300. (Note: This is not a new course.)
- ENGR 452 Petroleum Production Engineering (4). Prerequisite: ENGR 351 Covers topics in modern petroleum production engineering, including production technologies, production equipment, equipment design and optimization, well completion, tubing design, well performance evaluation (productivity index), inflow performance relationships (IPR), artificial lift and surface facilities. Four hours lecture/discussion per week. Preprequisite: ENGR 351 or consent of the instructor.

- ENGR 453 Reservoir Engineering (5). Fundamental equations of fluid flow through porous media, reservoir material balances, aquifer influx, well testing, and decline curve analysis. Methods for forecasting reservoir performance are covered using analytical models. Five hours lecture/discussion per week. Preprequisites: MATH 203 or 233, and ENGR 351 or consent of the instructor.
- ENGR 454 Drilling Engineering and Completion Technology (5). Fundamentals of drilling equipment, engineering design calculations, wellbore diagrams, drilling fluids, cement calculations, and casing design. Additional topics such as directional drilling as well as completion technologies are covered using practical examples and field applications as applied in the oil and natural gas well drilling operations. Four hours lecture/discussion and one three-hour laboratory per week. Prerequisites: ENGR 244 and 351 or consent of the instructor.

e) *List of elective courses that can be used to satisfy requirements for the program, specifying catalog number, title, units of credit, and prerequisites or co-requisites. Include proposed catalog descriptions and course approval sheets for all new courses. For graduate program proposals, identify whether each course is a graduate or undergraduate offering.*

None

f) *List of any new courses that are: (1) needed to initiate the program and (2) needed during the first two years after implementation. Only include proposed catalog descriptions for new courses. For graduate program proposals, identify whether each course is a graduate-level or undergraduate-level offering.*

The following new courses will be needed to initiate the two emphases. They will be offered during the first two years after implementation. The course catalog descriptions are given in (b) and (d) above.

- Biosystems and Agricultural Emphases. ENGR 341, 342, 441, 442.
- Petroleum Engineering Emphasis. ENGR 351, 452, 453, 454.

g) *For undergraduate programs, planned provisions for articulation of the proposed program with community college programs. In particular, designate the proposed program as similar or dissimilar to any transfer model curricula developed for compliance with SB 1440 (the STAR Act).*

N/A

h) *Advising "roadmaps" that have been developed.*

Each of the two emphases being proposed are satisfied by taking 23 units of upper division electives, which complete the 180 units required for graduation. A student intending to fulfill the appropriate requirements for one of two emphases will need to start taking the relevant elective courses in the fall quarter of her/his junior year. The representative roadmaps we have developed are included in Appendix B.

i) *Provision for meeting accreditation requirements, if applicable, and anticipated date of accreditation request (including the WASC Substantive Change process).*

The relevant accrediting agency is the Accreditation Board for Engineering and Technology (ABET). We will seek accreditation for our Engineering Sciences program based on our core engineering courses. We are taking care of that process separately from the two emphases being proposed here, i.e. we will seek ABET accreditation of our BS in Engineering Sciences. The emphases are not accredited separately from the BS.

ABET requires that institutions graduate a batch of students that have gone through the entire program before applying for accreditation. Therefore the earliest we can commence this process is AY 2014-2015, but we might have to wait a year or two longer as we fine-tune our curriculum and assessment process.

4) ***Need for the Proposed Program*** *It may be helpful to address the following areas:*

a) *List of other California State University campuses currently offering similar programs; list of neighboring institutions, public and private, currently offering similar programs.*

Only Cal Poly SLO and San Jose State University offer a general engineering degree, but those programs do not offer emphases or concentrations in either biosystems and agricultural engineering, or in petroleum engineering.

Both Cal Poly SLO and UC Davis offer full (not emphasis) Agricultural Engineering programs. No CSU offers a full Petroleum Engineering program.

Harvey Mudd College, one of the Claremont Colleges, offers a general engineering degree, but does not offer emphases or concentrations in either Biosystems/Agricultural Engineering or in Petroleum Engineering.

b) *List of any other curricula currently offered by the campus that are closely related to the proposed program.*

CSUB does not offer any programs closely related to what we are proposing here.

c) *Community participation, if any, in the planning process. This may include prospective employers of graduates.*

We have consulted with industry leaders in the local agricultural and energy sectors. We

did this at various meetings we conducted last year to ascertain their needs and extent of their support. We received input from the Society of Petroleum Engineers, as well as companies such as Paramount, Giumarra, and Grimmway Farms, Chevron, Occidental Petroleum, and Aera Energy. We also received input from the US Department of Agriculture, the Kern County Water Agency, Southern California Gas Company, Kennedy Jenks Consultants, TJ Cross Engineers, and KSI Engineering. We are happy to report that the *community is extremely supportive of engineering at CSUB*. Indeed, they are ready and eager to help us establish academically strong programs.

d) *Applicable workforce demand projections and other relevant data.*

Nationwide, the US Department of Labor projects 9% growth in Biosystems and Agricultural Engineering, and 17% growth in Petroleum Engineering. These engineering emphases will help CSUB address the shortage of technical know-how in the Southern San Joaquin Valley. This has been a constant theme during our conversations with local industry. They are especially worried about the impending graying of the engineering workforce, and the obvious upcoming shortage of engineering graduates.

e) If the program was proposed to meet society's need for the advancement of knowledge, please specify the need and explain how the program meets that need.
- *i) Note: Data Sources for Demonstrating Evidence of Need*
- *ii) APP Resources Web http://www.calstate.edu/app/resources.shtml*
- *iii) US Department of Labor, Bureau of Labor Statistics*
- *iv) California Labor Market Information*
- *v) Labor Forecast*

N/A

5) ***Student Demand*** *It may be helpful to address the following areas:*

a) *Evidence of student interest in enrolling in the proposed program. Types of evidence vary and may include national, statewide, and professional employment forecasts and surveys; petitions; lists of related associate degree programs at feeder community colleges; reports from community college transfer centers; and enrollments from feeder baccalaureate programs, for example.*

We are confident there will enough student demand for our programs. We advise students on a daily basis. Thus we know that our students are eager to enroll in majors which will prepare them for local industry jobs, especially in the petroleum industry, but their interest in not limited to that. Indeed, our pre-engineering and engineering students are looking for programs they can pursue here, as well as subsequent interesting work which they can obtain locally. The Engineering Sciences program is poised to grow rapidly in the near future; 146 applicants have been admitted to the freshman Engineering Sciences class of 2013/2014. If only a third of these admitted students actually come to CSUB (as is the case for all majors across the university), we

should be getting 50 freshmen or so in Fall 2013. This is already much more than our original (conservative) estimate of 30 new freshmen in AY 2013-14. Indeed, 50 new students was our original estimate where our freshmen enrollment would taper off. We guessed that we would reach this value in Fall 2015.

b) *Issues of diversity and access to the university considered when planning this program.*

CSUB is a Hispanic-serving institution. Our pre-engineering program has 51% Hispanic students. Furthermore, we have around 21% female students in pre-engineering. This is significantly less than the female representation across campus, which is around 61%. Once our programs become better established, we will focus more of our efforts towards outreach of female students to achieve better representation. We will also implement programs involving female engineers from local industry to help retain these students.

c) For master's degree proposals, the number of declared undergraduate majors in closely allied disciplines and the degree production over the preceding three years for the corresponding baccalaureate program(s), if they exist.

N/A

d) Professional uses of the proposed program.

Our graduates will perform technical and managerial engineering tasks. Our two emphases focus on technical needs of local industry.

e) *The expected number students in the program in the year of initiation and three years and five years thereafter. The expected number of graduates in the year of initiation, and three years and five years thereafter.*

We estimate the following numbers of students based on the number of Engineering Sciences students, our experience advising them, and our outreach plans:

	2013/2014	2016/2017	2018/2019
ENGR (total)	80	130	145
Bio/Ag	7	15	20
Petroleum	22	36	40

Similarly, we estimate the following numbers of graduates:

	2013/2014	2016/2017	2018/2019
ENGR (total)	6	19	29
Bio/Ag	0	8	10
Petroleum	0	18	20

6) ***Existing Support Resources for the Proposed Program***

a) *Faculty who would teach in the program, indicating rank, appointment status, and highest degree earned. For master's degrees, include faculty publications or curriculum vitae.*

No new faculty will be hired specifically to teach in these two new emphases. One of our tenure-track faculty members, Assistant Professor Dr. Luis Cabrales will be the point person in charge of coordinating and establishing strategies and priorities in the Biosystems and Agricultural Emphasis. A similar role will be played by tenure-track Associate Professor Dr. Dana Abouelnasr in the Petroleum Engineering Emphasis. In addition, we have just hired a new tenure-track faculty member to start in Fall 2013, Assistant Professor Dr. Griffiths Atungulu, who will be especially helpful with the Biosystems and Agricultural Engineering Emphasis. ***We intend to staff new courses with faculty we have already hired***; however, we will avail of expertise in local industry to teach the elective courses occasionally to help foster links with industry.

b) *Describe special space, facilities, library resources, equipment, academic technology, or special materials that would be used in support of the proposed program.*

The new emphases will require laboratory space and equipment, as well as some library resources. We will use the laboratories in the Engineering Complex (which was funded by the Department of Education grant). We will purchase the equipment required for the laboratory courses with grant funds. We also anticipate industry donations of necessary equipment, especially for the petroleum engineering labs. Finally, we will continue writing grant proposals for external funding.

We have external funds as shown in the table below. We also indicate projected expenditures associated with our program.

	2013-14	2014-15	2015-16
USDA[1]	$147,500		
Department of Education[2]	$866,277	$869,965	$869,824
Department of Education[3]	$219,000	$219,000	$219,000
Salaries, fringe and benefits[4]	-$437,078	-$437,078	-$437,078
Laboratory equipment (see details below)	-$253,476 (ENGR 441-442)	-$283,000 (ENGR 454)	
Library resources (see details below)	$5,400	$2,400	$2,400
Total available for other purposes	$536,823	$366,487	$649,346

7) ***Additional Support Resources Required*** *Note: If additional support resources will be needed to implement and maintain the program, a statement by the responsible administrator(s) should be attached to the proposal assuring that such resources will be provided.*

a) *Any additional faculty or staff support positions needed to implement the proposed program.*

N/A

b) *The amount of additional lecture and/or laboratory space required to initiate and to sustain the program over the next five years. Indicate any additional special facilities that will be required. If the space is under construction, what is the projected occupancy date? If the space is planned, indicate campus-wide priority of the facility, capital outlay program priority, and projected date of occupancy.*

[1] Project title: *Broadening Access to Modern STEAM Education in High Needs Southern San Joaquin Valley.*

[2] Project title: *Developing New Engineering Degree Options for Underserved Hispanic Students in the Southern San Joaquin Valley.*

[3] Project title: *Turning a Gateway into a Pathway to STEM Degrees for Hispanic and Low Income Students in the Southern San Joaquin Valley.*

[4] Salaries, fringe and benefits projected for program faculty and staff.

The additional space required is in the Engineering Complex. These facilities have already been finished and are already in use.

c) *Any additional library resources needed. Indicate the commitment of the campus either to purchase or borrow through interlibrary loan these additional resources.*

After consultation with our Library liaison, Ying Zhong, we have come to the following estimates:

- Biosystems and Agricultural Engineering Emphasis. We will purchase an institutional subscription to American Society of Agricultural and Biological Engineers (ASABE). This costs $900 per year, and it comes with the added incentive of free access to ASABE books for our students. These will be the required textbooks in ENGR 340, 341, 440, and 442.
- Petroleum Engineering Emphasis. This will require an initial purchase of about $3,000 in books, which will be a one-time expense. In addition we will need to pay $1,500 per year for institutional access to the Society of Petroleum Engineers (SPE) package of journals.

We will arrange for these library resources to be purchased from our grants. Clearly, we have the funds to do this for the next three years. After that, we anticipate paying for these materials from additional external funds.

d) *Additional academic technology, equipment, or specialized materials that will be (1) needed to implement the program and (2) needed during the first two years after initiation. Indicate the source of funds and priority to secure these resource needs.*

We will arrange for any equipment to be purchased from our grants, or through local industry donations. Our estimates for the laboratory equipment need in the new courses are as follows.

- Environmental Engineering (ENGR 441) and Food and Bioprocess Engineering Unit Operations (ENGR 442). These pieces of equipment will be needed in AY 2013-14:

Qty	Description	Unit Price
1	Enzymatic Reactor	$43,156
1	Advanced Fuel Cell Trainer	$30,696
1	Freeze Dryer	$15,000
1	Spray Dryer	$25,000
1	Fluidized Bed	$37,587
1	UV-Vis Spectrophotometers	$10,000
1	Ion Exchange	$20,516

1	Aerobic Digester	$25,741
1	Anaerobic Digester	$29,406
	Subtotal	$253,476

- Drilling Engineering and Completion Technology (ENGR 454). These pieces of equipment will be needed in AY 2014-15:

Qty	Description	Unit Price
1	Porosimeter	$35,000
1	Resistivity	$45,000
1	Acoustic Velocity	$47,000
1	Capillary Pressure	$30,000
1	Permeability Gas	$22,000
1	Permeability Liquid	$24,000
1	Permeameter	$80,000
	Subtotal	$283,000

Most of the new electives will be offered on a two-year rotation basis. The schedule for the necessary new electives is as follows:

	F-13	W-14	S-14	F-14	W-15	S-15	F-15	W-16	S-16
ENGR 340				X					
ENGR 341		X						X	
ENGR 342	X						X		
ENGR 351	X			X			X		
ENGR 440						X			
ENGR 441			X						X
ENGR 442					X				
ENGR 452		X						X	
ENGR 453			X						X
ENGR 454					X				

We will not need to cancel any other courses in order to offer these new electives. We have sufficient faculty to staff these classes. Again, ***these courses will be taught by faculty we have already hired under the auspices of our federal grants***.

Clearly, our grants have more than enough funds to support the needs of these two new emphases.

Appendix A

Bachelor of Science in Engineering Sciences
Assessment Plan

Our Program Goals aim to enable students to have the following characteristic by the time of graduation:

1. To have skills required for employment by industry or government in fields such as design, research and development, experimentation and testing, manufacturing, and technical sales.
2. To be able to assume an increasing level of responsibility and leadership within their respective organizations.
3. To communicate effectively and work collaboratively in multidisciplinary and multicultural work environments.
4. To recognize and understand the global, environmental, social, and ethical contexts of their work.
5. Be academically prepared to pursue graduate studies and/or certificate programs in a field of engineering.
6. Be committed to lifelong learning to enhance their careers.

The Student Learning Outcomes (SLOs) for our program are essentially taken from the Accreditation Board for Engineering and Technology (ABET). The relevant SLOs are contained in ABET's "Criterion 3" for accreditation of programs. They are labeled a through k:

3.a Applies knowledge of mathematics, science and engineering.
3.b Designs and conducts experiments; analyzes and interprets data.
3.c Designs a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3.d Functions in multidisciplinary teams.
3.e Identifies, formulates, and solves engineering problems.
3.f Evaluates ethical and professional responsibility and behavior.
3.g Communicates effectively.
3.h Evaluates the impact of engineering solutions in a global, economic, environmental and societal context.
3.i Recognizes and expresses the value of engaging in life-long learning.
3.j Evaluates contemporary issues.
3.k Utilizes the techniques, skills, and modern engineering tools necessary for engineering practice.

The explicit links between the program objectives and SLOs are provided by the tables below. The courses cited in those tables are the following (1-4 are cognates, 5-13 are Engineering core requirements):

1. PHYS 222 – Classical Physics II
2. PHIL 316 – Professional Ethics
3. COMM 108 – Strategy Public Communication
4. BIOL 103 – Principles of Ecology
5. ENGR 161 – Introduction to Engineering Design
6. ENGR 207 – Electric Circuits
7. ENGR 240 – Analytic Mechanics, Statics
8. ENGR 244 – Properties of Materials
9. ENGR 200 – Engineering Modeling and Analysis
10. ENGR 310 – Thermodynamics
11. ENGR 320 – Fluid Mechanics
12. ENGR 330 – Heat Transfer
13. ENGR 490 – Senior Seminar

Table 1. Engineering Sciences Course Matrix (I=Introduced, D=Developed, M=Mastered)

SLO	E161*	Cognates**	E207	E240	E244	E300	E310	E320	E330	E490
3.a		I	D	D	D	D	M	M	M	
3.b	I	I	D		D			M		M
3.c	I		D					D		M
3.d	I	I	D		D					M
3.e	I		D	D	D	D	M	M	M	M
3.f	I	D								M
3.g	I	D	D							M
3.h	I	D								M
3.i	I	D				D				M
3.j	I	D								M
3.k			I	D	D	D	M	M	M	M

*E stands for ENGR courses.
**SLOs will be assessed within the department in conversations across the campus.

We would like to make two important points about the assessment of our program:

1. Most assessment tools will be implemented in our courses. The instructor of record will be responsible for this task. The analysis of the raw assessment data will be performed by teams of at least two faculty members from the Department of Physics and Engineering. Except where noted below, SLOs will be assessed in various courses on alternate academic years, providing a two-year rotation assessment schedule in each course. That is, a SLO will be assessed in a particular course either on an even-numbered AY (e.g. 2012-13), or odd –numbered AY (e.g. 2013-14).
2. The assessment data will be collected, aggregated, and analyzed by the faculty of the department under the leadership of the Engineering Sciences Program Coordinator (presently

the same as the Chair of the department). The results of this process will then be used to improve course content and/or alter pedagogy.

In the table below, we refer to a “four-point scale rubric” for reporting many of our results. This scale corresponds to “unsatisfactory”, “developing”, “satisfactory”, and “exemplary” performance.

Table 2. Assessment/Assessment Data Collection Plan						
Program Goals	Student Learning Outcomes (SLOs) Related to Program Goals (ABET Requirements)	Courses where SLOs are Assessed	SLO Level Introduced (I), Developed (D), Mastered (M)	Type of Assessment	SLO Assessment Schedule	How Results Will be Reported
1. To have skills required to be employed by industry or government in fields such as design, research and development, experimentation and testing, manufacturing, and technical sales. 5. Be academically prepared to pursue graduate studies and/or certificate programs in a field of engineering.	3a. Applies knowledge of mathematics, science and engineering	PHYS 222	I	Embedded exam questions	Even-numbered AY	% of all students who scored > 70%
		ENGR 207	D		Odd-numbered AY	
		ENGR 240	D		Even-numbered AY	
		ENGR 244	D		Odd-numbered AY	
		ENGR 300	D		Even-numbered AY	
		ENGR 310	M		Odd-numbered AY	
		ENGR 320	M		Even-numbered AY	
		ENGR 330	M		Odd-numbered AY	

Table 2. Assessment/Assessment Data Collection Plan (continued)						
See Program Goal #1. See Program Goal #5.	3b. Designs and conducts experiments; analyzes and interprets data.	ENGR 161	I	Project	Odd-numbered AY	Rubric score using four-point scale
		ENGR 207	D	Lab experiment and report	Even-numbered AY	
		ENGR 244	D		Odd-numbered AY	
		ENGR 320	M		Even-numbered AY	
		ENGR 490	M	Project	Odd-numbered AY	
See Program Goal #1. 4. Recognize and understand the global, environmental, social, and ethical contexts of their work. See Program Goal #5.	3c. Designs a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	ENGR 161	I	Project	Even-numbered AY	Rubric score using four-point scale
		ENGR 207	D	Lab experiment and report	Odd-numbered AY	
		ENGR 320	D		Even-numbered AY	
		ENGR 490	M	Project	Odd-numbered AY	

Table 2. Assessment/Assessment Data Collection Plan (continued)						
3. Communicate effectively and work collaboratively in multidisciplinary and multicultural work environments.	3d. Functions in multidisciplinary teams.	ENGR 161	I	Lab experiment and report	Even-numbered AY	Rubric score using four-point scale
		ENGR 207	D		Odd-numbered AY	
		ENGR 244	D		Even-numbered AY	
		ENGR 490	M	Project	Odd-numbered AY	
See Program Goal #1. See Program Goal #5.	3e. Identifies, formulates, and solves engineering problems.	ENGR 161	I	Embedded exam questions	Odd-numbered AY	% of all students who scored > 70%
		ENGR 207	D		Even-numbered AY	
		ENGR 240	D		Odd-numbered AY	
		ENGR 244	D		Even-numbered AY	
		ENGR 300	D		Odd-numbered AY	
		ENGR 310	M		Even-numbered AY	
		ENGR 320	M		Odd-numbered AY	
		ENGR 330	M		Even-numbered AY	
See Program Goal #2. See Program Goal #4.	3f. Models ethical and professional responsibility	ENGR 161	I	Student questionnaire	Odd-numbered AY	Rubric score using four-point scale
		PHIL 316	D		Even-numbered AY	
		ENGR 490	M		Odd-numbered AY	

Table 2. Assessment/Assessment Data Collection Plan (continued)						
See Program Goal #2. See Program Goal #3.	3g. Communicates effectively	ENGR 161	I	Project	Even-numbered AY	Rubric score using four-point scale
		COMM 108	D	Presentation	Odd-numbered AY	
		ENGR 207	D	Lab experiment and report	Even-numbered AY	
		ENGR 490	M	Project	Odd-numbered AY	
See Program Goal #1. See Program Goal #4.	3h. Evaluates impact of engineering solutions in a global, economic, environmental and societal context.	ENGR 161	I	Project	Even-numbered AY	Rubric score using four-point scale
		BIOL 103	D	Embedded exam questions	Odd-numbered AY	
		ENGR 490	M	Project	Even-numbered AY	
6. Be committed to lifelong learning to enhance their careers.	3i. Recognizes and expresses value of engaging in life long learning	ENGR 161	I	Project	Odd-numbered AY	Rubric score using four-point scale
		PHIL 316	D	Embedded exam questions	Even-numbered AY	
		ENGR 300	D		Odd-numbered AY	
		ENGR 490	M	Project	Even-numbered AY	
See Program Goal #1. See Program Goal #4.	3j. Analyzes contemporary issues	ENGR 161	I	Project	Even-numbered AY	Rubric score using four-point scale
		PHIL 316	D	Embedded exam questions	Odd-numbered AY	
		ENGR 490	M	Project	Odd-numbered AY	

See Program Goal #1. See Program Goal #5.	3k. Utilizes techniques, skills and modern engineering tools necessary for engineering practice.	ENGR 207	I	Embedded exam questions	Odd-numbered AY	% of all students who scored > 70%
		ENGR 240	D		Even-numbered AY	
		ENGR 244	D		Odd-numbered AY	
		ENGR 300	D		Even-numbered AY	
		ENGR 310	M		Odd-numbered AY	
		ENGR 320	M		Even-numbered AY	
		ENGR 330	M		Odd-numbered AY	

Appendix B

Sample roadmaps for

BS in Engineering Sciences with Emphasis in Biosystems and Agricultural Engineering
and
BS in Engineering Sciences with Emphasis in Petroleum Engineering

Roadmap Sample 1: 4-year schedule for graduation with a *BS in Engineering Sciences with Emphasis in Biosystems and Agricultural Engineering*

Quarter Year	Fall	Winter	Spring
Freshman 1 **45 units**	MATH 201 or 231[1] (5) CHEM 211[1] (5) CMPS 150 (1) CSUB 101 (2) **13 units**	MATH 202 or 232 (5) CMPS 221 (5) ENGR 161 (2) GE Area D (5) **17 units**	MATH 203 or 233 (5) B2 – BIOL 103 (5) A2 – ENGL 110 (5) **15 units**
Sophomore 2 **48 units**	MATH 204 or 234 (5) PHYS 221 (6) A1 – COMM 108 (5) **16 units**	GE Area C (5) PHYS 222 (6) ENGR 240 (5) **16 units**	PHYS 223 (6) ENGR 207 (5) GE Area C (5) **16 units**
Junior 3 **40 units**	ENGR 300 (5) ENGR 342 (4) ENGR 244 (5) **14 units**	ENGR 310 (4) ENGR 341 (3) Theme 2-PHIL 316 (5) **12 units**	ENGR 320 (5) ENGR 441 (4) GRE (5) **14 units**
Senior 4 **47 units**	ENGR 490A (2) ENGR 330 (4) ENGR 340 (4) D3 – PLSI 101 (5) **15 units**	ENGR 490B (2) ENGR 442 (4) GE Area D (5) US History (5) **16 units**	ENGR 490C (2) ENGR 440 (4) Theme 3 (5) GE Area C (5) **16 units**

GE Areas B1 & B3 are satisfied by coursework within the major.
Satisfying Area D3 with Plsi 101 or Inst 275 also satisfies US institutions requirement

[1] Satisfactory score on a Placement test or other entrance requirement needed

Roadmap Sample 2: 4-year schedule for graduation with a *BS in Engineering Sciences with Emphasis in Biosystems and Agricultural Engineering*

Quarter Year	Fall	Winter	Spring
Freshman 1 **45 units**	MATH 201 or 231[1] (5) CHEM 211[1] (5) CMPS 150 (1) CSUB 101 (2) **13 units**	MATH 202 or 232 (5) CMPS 221 (5) ENGR 161 (2) GE Area D (5) **17 units**	MATH 203 or 233 (5) B2 – BIOL 103 (5) A2 – ENGL 110 (5) **15 units**
Sophomore 2 **48 units**	MATH 204 or 234 (5) PHYS 221 (6) A1 – COMM 108 (5) **16 units**	GE Area C (5) PHYS 222 (6) ENGR 240 (5) **16 units**	PHYS 223 (6) ENGR 207 (5) GE Area C (5) **16 units**
Junior 3 **40 units**	ENGR 300 (5) ENGR 340 (4) ENGR 244 (5) **14 units**	ENGR 310 (4) US History (5) Theme 2-PHIL 316 (5) **14 units**	ENGR 320 (5) ENGR 440 (4) GRE (5) **14 units**
Senior 4 **47 units**	ENGR 490A (2) ENGR 330 (4) ENGR 342 (4) D3 – PLSI 101 (5) **15 units**	ENGR 490B (2) ENGR 341 (3) GE Area D (5) ENGR 442 (4) **14 units**	ENGR 490C (2) ENGR 441 (4) Theme 3 (5) GE Area C (5) **16 units**

GE Areas B1 & B3 are satisfied by coursework within the major.
Satisfying Area D3 with Plsi 101 or Inst 275 also satisfies US institutions requirement

[1] Satisfactory score on a Placement test or other entrance requirement needed

Roadmap Sample 1: 4-year schedule for graduation with a *BS in Engineering Sciences with Emphasis in Petroleum Engineering*

Quarter Year	Fall	Winter	Spring
Freshman 1 **45 units**	MATH 201 or 231[1] (5) CHEM 211[1] (5) CMPS 150 (1) CSUB 101 (2) **13 units**	MATH 202 or 232 (5) CMPS 221 (5) ENGR 161 (2) GE Area D (5) **17 units**	MATH 203 or 233 (5) B2 – BIOL 103 (5) A2 – ENGL 110 (5) **15 units**
Sophomore 2 **48 units**	MATH 204 or 234 (5) PHYS 221 (6) A1 – COMM 108 (5) **16 units**	GE Area C (5) PHYS 222 (6) ENGR 240 (5) **16 units**	PHYS 223 (6) ENGR 207 (5) GE Area C (5) **16 units**
Junior 3 **43 units**	ENGR 300 (5) ENGR 351 (5) ENGR 244 (5) **15 units**	ENGR 310 (4) ENGR 452 (4) Theme 2-PHIL 316 (5) **13 units**	ENGR 320 (5) ENGR 453 (5) GRE (5) **15 units**
Senior 4 **44 units**	ENGR 490A (2) ENGR 330 (4) GE Area D (5) D3 – PLSI 101 (5) **16 units**	ENGR 490B (2) ENGR 454 (5) US History (5) **12 units**	ENGR 490C (2) ENGR 426 (4) Theme 3 (5) GE Area C (5) **16 units**

GE Areas B1 & B3 are satisfied by coursework within the major.
Satisfying Area D3 with Plsi 101 or Inst 275 also satisfies US institutions requirement

[1] Satisfactory score on a Placement test or other entrance requirement needed

Roadmap Sample 2: 4-year schedule for graduation with a *BS in Engineering Sciences in Petroleum Engineering*

Quarter Year	Fall	Winter	Spring
Freshman 1 **45 units**	MATH 201 or 231[1] (5) CHEM 211[1] (5) CMPS 150 (1) CSUB 101 (2) **13 units**	MATH 202 or 232 (5) CMPS 221 (5) ENGR 161 (2) GE Area D (5) **17 units**	MATH 203 or 233 (5) B2 – BIOL 103 (5) A2 – ENGL 110 (5) **15 units**
Sophomore 2 **48 units**	MATH 204 or 234 (5) PHYS 221 (6) A1 – COMM 108 (5) **16 units**	GE Area C (5) PHYS 222 (6) ENGR 240 (5) **16 units**	PHYS 223 (6) ENGR 207 (5) GE Area C (5) **16 units**
Junior 3 **43 units**	ENGR 300 (5) ENGR 351 (5) ENGR 244 (5) **15 units**	ENGR 310 (4) ENGR 454 (5) Theme 2-PHIL 316 (5) **14 units**	ENGR 320 (5) ENGR 426 (4) GRE (5) **14 units**
Senior 4 **44 units**	ENGR 490A (2) ENGR 330 (4) GE Area C (5) D3 – PLSI 101 (5) **16 units**	ENGR 490B (2) ENGR 452 (4) GE Area D (5) US History (5) **16 units**	ENGR 490C (2) ENGR 453 (5) Theme 3 (5) **12 units**

GE Areas B1 & B3 are satisfied by coursework within the major.
Satisfying Area D3 with Plsi 101 or Inst 275 also satisfies US institutions requirement

[1] Satisfactory score on a Placement test or other entrance requirement needed

Appendix C. Form: Request for Approval New Course/Course Change

Request for Approval New Course/Course Change

Submitted by: Jorge Talamantes x2335
Department Contact and Phone extension

Effective Term Fall 2013
Quarter & Year

Approved by: _____
Curriculum Committee Chair/Date

Approved by: _____
Department Chair/Dat

Approved by: _____
GE/UWR Committee Chair/Date

Approved by: _____
School Dean/Date

Approved by: _____
Director of Academic Operations/Date

GE/UWR Effective Term

Crse ID# (1)	Crse Subj	Crse #	Total Units	Split Units	Class APDB Mapping Value/CS# (2)	Hegis (3)	Course Title (this field in PeopleSoft only allows for 30 spaces)	CLEV (4)	Grading Basis (5)	Test Codes, Student Groups and/or Pre-requisites	Corequisites	Requirement Designation and Attributes	GE/GRE attributes remove or continue(6)	Check if new or revised course description (7)	Action: title change, unit change, add a requisite, change grade basis, add new course etc. (8)
	ENGR	340	4	4 LEC /DIS	2	19021	Soil & Water Resource Management	01	N	ENGR 240	ENGR 300 or consent of instructor			X	Change in Requisite and Co-Requisite
	ENGR	341	3	3 LEC /DIS	2	19021	Engineering Principles of Agricultural Machines	01	N	ENGR 240 or consent of the instructor	None			X	New course
	ENGR	342	4	4 LEC /DIS	2	19021	Bioprocess Engineering	01	N	ENGR 240 and CHEM 211 or consent of the instructor	None			X	New course
	ENGR	351	5	5 LEC /DIS	2	19021	Fundamentals and Transport of Petroleum Engineering	01	N	CHEM 211, PHYS 221, and MATH 202 or 232, or consent of the instructor.	None			X	New course

	ENGR	440	4	4 LEC /DIS	2	19021	Biological System Applications	01	N	ENGR 320 or consent of the instructor	None			X	Course Number Change, Change Pre-requisite
	ENGR	441	4	3 LEC /DIS 2 LAB	2-LEC/DIS 16-LAB	19021	Environmental Engineering	01	N	ENGR 320 or consent of the instructor	None			X	New course
	ENGR	442	4	3 LEC /DIS 2 LAB	2-LEC/DIS 16-LAB	19021	Food and Bioprocess Engineering Unit Operations	01	N	ENGR 330 or consent of the instructor	None			X	New course
	ENGR	452	4	4 LEC /DIS	2	19021	Petroleum Production Engineering	01	N	ENGR 351 or consent of the instructor	None			X	New course
	ENGR	453	5	5 LEC /DIS	2	19021	Reservoir Engineering	01	N	MATH 203 OR 233, AND ENGR 351, or consent of the instructor	None			X	New course
	ENGR	454	5	4LEC/DIS 2 LAB	2-LEC/DIS 16-LAB	19021	Drilling Engineering and Completion Technology	01	N	ENGR 244, and 351, or consent of the instructor	None			X	New course

(1) Every course in PeopleSoft has a unique course ID: for all new courses a course ID number will be generated.

(2) Provide Class APDB Mapping Value or CS#. Refer to PeopleSoft Components spreadsheet.

(3) Hegis (previously known as CIP code) can be found in Course Catalog. Look at an existing course in your dept for Hegis (CIP code). Check offerings tab at Hegis link.

(4) Course Level = CLEV: 01=Lower; 02=Upper, 03=Graduate

(5) Grading Basis: N=Graded; B=credit/no credit; P=remedial; S=Graded w/RP; T=CR/NC w/RP (S & T grade basis must be approved by Director of Academic Operations and Support).

(6) Changes to Gen Ed (Area/Theme) and GRE approved courses require signature by appropriate Committee Chair.

(7) Attach and send an electronic copy to Academic Scheduling of all new or revised course descriptions.

(8) What action needs to be taken with the course.

Appendix D. Course Proposals and Syllabi.

Curriculum Proposal
Course change: ENGR 340

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case changing the prerequisites of a current course:

   ENGR 340 Soil and Water Resource Management (4)
   Soil and water management systems and practices including hydrology, surface drainage, open channels, and erosion, subsurface drainage, impoundments and irrigation. Four hours lecture/discussion per week. Prerequisites: ~~PHYS 222~~ ENGR 240. Perequisite of corequisite: ENGR 300 or consent of instructor.

3. **Resource Implications**. No additional faculty resources will be required for this course. The department will not need to make changes to other areas of the curriculum to accommodate these requirements. This class will be offered every other year in the Fall quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed new prerequisites of the course ENGR 240 and ENGR 300 are requested to assure that the students taking this course are properly prepared.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

Curriculum Proposal
New Course: ENGR 341

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 341 Engineering Principles of Agricultural Machines (3)
   Application of machine systems to agricultural production and biological processing. Functional design and analysis of equipment. This course is designed to provide a broad foundation for understanding machine system. Machine systems are an integral part of many agricultural operations from field production to post-harvest processing, storage, transportation, and bio-based processing. Three hours lecture/discussion per week. Prerequisites: ENGR 240 or consent of the instructor.

3. **Resource Implications**. Only additional part-time faculty resources will be required for this course. This extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by one part-time instructor. This class will be offered every other year in the Winter quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 341, Engineering Principles of Agricultural Machines (3 credits)

Course Description: Application of machine systems to agricultural production and biological processing. Functional design and analysis of equipment. This course is designed to provide a broad foundation for understanding machine system. Machine systems are an integral part of many agricultural operations from field production to post-harvest processing, storage, transportation, and bio-based processing. Three hours lecture/discussion per week.

Prerequisite(s):

- ENG 240, Statics

Text: Recommended but not required:

- Engineering Principles of Agricultural Machines, Second edition, Ajit K. Srivastava, ASABE, ISBN: 1-892769-50-6.
- Other: Introduction to Agricultural Engineering Technology, Harry Field, Springer, ISBN: 978-0-387-36913

Course Outcomes: This course requires students to demonstrate the following:

- Identify various farm, construction, and processing machinery
- Explain various application of farm, construction, and processing machinery
- Select, recommend and manage equipment based on different needs
- Identify factors that influence production, and improvements that can be made to machine usage.

Tentative Schedule:

I. Agricultural Mechanization **1 week**

- Physical Variables, Dimensions and Units
- Functional Analysis of Agricultural Machines
- Dimensional Analysis

II. Engine Power for Agricultural Machines **1 week**

- Thermodynamic limits of engine performance
- Heat losses
- Mechanical losses

III. Electrical Power for Agricultural Machines **1 week**

- Motor Components
- Single phase induction motors
- Three phase induction motors
- Dual voltage motors

. **IV. Mechanical Power Transmission** **1 week**

- V-Belt Drives
- Chain Drives
- Power Take off devices

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. **V. Fluid Power, mechatronics and control** **1 week**

- Pumps
- Valves
- Actuators

. **VI. Precision Agriculture** **1 week**

- Sensors
- Global Positioning System
- Geographical information systems

VII. Tractor Hitching, traction, and testing **1 week**

- Hitching
- Tires and traction
- Tractor testing

VIII. Soil Tillage **1 week**

- Tillage Methods
- Mechanics of tillage

IX. Crop Planting **1 week**

- Methods and Equipment
- Functional Processes

X. Chemical application **1 week**

- Application of Granular chemicals
- Application of liquid chemicals

Grades:

Homework Assignments	30%
Midterm exam	30%
Final exam	40%

Curriculum Proposal
New Course: ENGR 342

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 342 Bioprocess engineering (4)
   Engineering principles, processes and techniques for using biological agents such as cells, enzymes or antibodies for the production of chemicals, food, biofuels and pharmaceuticals, and waste treatment. The course includes stoichiometry and kinetics of reactions that employ biological agents; design, analysis and operation of reactors; and product recovery and purification.Four hours lecture/discussion per week. Prerequisites: ENGR 240 and CHEM 211 or consent of the instructor.

3. **Resource Implications**. Only additional faculty resources will be required for this course. This extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by one of the faculty members. This class will be offered every other year in the Fall quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 342, Bioprocess Engineering (4 credits)

Course Description: Engineering principles, processes and techniques for using biological agents such as cells, enzymes or antibodies for the production of chemicals, food, biofuels and pharmaceuticals, and waste treatment. The course includes stoichiometry and kinetics of reactions that employ biological agents; design, analysis and operation of reactors; and product recovery and purification.Four hours lecture/discussion per week.

Prerequisite(s):

- CHEM 211, Principles of General Chemistry I
- ENG 240, Statics

Text: Recommended but not required:

- "Bioprocess Engineering Principles", Pauline Doran, Academic press, Second Edition (2012), ISBN: 978-0122208515

Course Outcomes: This course requires students to demonstrate the following:

- Describe major processes in bioprocess engineering
- Describe the physical concepts and mathematical methods for design, scale up and operation of processing plant and equipment.
- Apply the engineering principles and methods for material and energy balances.
- Estimate and predict operation conditions, equipment dimensions, and process parameters.

Tentative Schedule:

I. Introduction to Engineering Calculations **1 week**

- Physical Variables, Dimensions and Units
- Force and Weight
- Standard Conditions and Ideal Gases
- Stoichiometry
- Presentation and Analysis of Data

II. Material and Energy Balances **1 week**

- Thermodynamic Preliminaries
- Law of Conservation of Mass
- Procedures for Material-Balance Calculations
- General Energy-Balance Equations

III. Unsteady state material and Energy Balances **1 week**

- Unsteady-state Material-Balance Equations
- Unsteady-state Energy-Balance Equations
- Solving Unsteady-State Mass Balance
- Solving Unsteady-State Energy Balance

. **IV. Fluid Flow and Mixing** **1 week**

- Fluids in Motion
- Momentum Transfer
- Viscosity Measurements
- Scale-up of Mixing Systems

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. **V. Heat Transfer** **1 week**

- Heat Transfer Equipment
- Mechanics of Heat Transfer
- Design Equations for Heat-Transfer Systems
- Scale-up of Mixing Systems

. **VI. Mass Transfer** **1 week**

- Molecular Diffusion
- Film Theory
- Mass-Transfer Correlations

VII. Unit Operations **1 week**

- Filtration
- Centrifugation
- Aqueous Two-Phase Liquid Extraction

VIII. Homogeneous Reactions **1 week**

- Basic Reaction Theory
- Calculation of Reaction Rates from Experimental Data
- General Reaction Kinetics for Biological Systems

IX. Heterogeneous Reactions **1 week**

- Heterogeneous Reactions in Bioprocessing
- Concentration Gradients and Reaction Rates
- Internal Mass-Transfer and Reaction

X. Reaction Engineering **1 week**

- Bioreactor Configurations
- Monitoring and Control of Bioreactors

Grades:

Homework Assignments	30%
Midterm exam	30%
Final exam	40%

Curriculum Proposal
New Course: ENGR 351

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 351 Fundamentals and Transport in Petroleum Engineering (5)
   Introduction to fundamental concepts in petroleum engineering. Topics include the origin, migration and accumulation of petroleum, properties of reservoir rocks and fluids. Introduces petroleum exploration, reservoir engineering, drilling technology, well completion, and production engineering. Five hours lecture/discussion per week. Prerequisites: CHEM 211, PHYS 221, and MATH 202 or 232, or consent of the instructor.

3. **Resource Implications**. Only additional part-time faculty resources will be required for this course. The extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by a part-time instructor. This class will be offered every year in the fall quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to petroleum engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 351, Fundamentals and Transport in Petroleum Engineering (5 credits)

Course Description: Introduction to fundamental concepts in petroleum engineering. Topics include the origin, migration and accumulation of petroleum, properties of reservoir rocks and fluids. Introduces petroleum exploration, reservoir engineering, drilling technology, well completion, and production engineering. Five hours lecture/discussion per week.

Prerequisite(s):

- CHEM 211, Principles of General Chemistry I
- MATH 202, Calculus II, or MATH 232, Calculus for Engineering Sciences
- PHYS 221, Classical Physics 1

Text: Recommended but not required:

- "Petroleum Reservoir Rock and Fluid Properties", A. Dandekar, CRC Press (2006), ISBN: 0-8493-3043-2

Course Outcomes: This course requires students to demonstrate the following:

- Describe sources of petroleum and petroleum migration through reservoirs
- Describe fundamental rock and fluid properties and their roles in the flow of fluids in hydrocarbon reservoirs
- Quantitatively evaluate transport phenomena occurring in oil and gas reservoirs
- Describe major processes in petroleum engineering

Tentative Schedule:

I. Petroleum Industry 1 week
- History of Petroleum Engineering
- Geology
- Formation Evaluation
  - Fundamentals of Logging
  - Conventional Logs and interpretation
  - SP logs, resistivity Logs, acoustic Logs, Gamma Ray Logs, Litho-density Logs

II. Properties of Rocks and Fluids 1 weeks
- Porosity, Permeability, Saturation
- Rock mechanics – Compressibility
- PVT Analysis
- Gas properties

III. Single-Phase Fluid Flow 2 weeks
- Darcy's law
- Material Balance (basic concepts)

IV. Multi-Phase Reservoir Properties and Energy Transport 2 weeks
- Relative Permealibities
- Steady State flow, Transient Flow, Pseudo-steady state flow

- Continuity Equation , Mass Conservation, Transport Equation

V. Drilling 1 weeks

- Basic Concepts
- Drilling Strings
- Drilling Fluids

VI. Reservoir Engineering 2 weeks

- Field Development
- Production Forecasting
- Economic Evaluations

VII. Production Engineering 1 weeks

- Production Systems and surface facilities
- Artificial lift
- Optimization

Grades:

Class Participation	10%
Homework Assignments	10%
Midterm exam	40%
Final exam	40%

Curriculum Proposal
Course change: ENGR 440

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case changing the catalog number and prerequisites of a current course:

   ENGR ~~430~~ 440 Biological Systems applications (4)
   Principles of heat and mass transfer in the context of biological (biomedical, bioprocessing, bioenvironmental) systems. Physical understanding of transport processes and simple reaction rates with application to examples from plant, animal, and human biology. Four hours lecture/discussion per week. Prerequisite or corequisite: ENGR 320 or consent of the instructor. ~~Prerequisites: ENGR 300.~~

3. **Resource Implications**. No additional faculty resources will be required for this course. The department will not need to make changes to other areas of the curriculum to accommodate these requirements. This class will be offered every other year in the Spring quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed new catalog number is requested to have all the electives of the biological and agricultural engineering emphasis with a catalog number starting with ENGR 34X or ENGR 44X. This will facilitate the identification of these courses. The course ENGR 320 is already a prerequisite for the course. It is proposed to have ENGR 320 as a corequisite as well. ENGR 320 is offered in the Spring. This proposed change will assure that the students can take these courses concurrently and this will help them in graduating on time. ENGR 300 is removed from the prerequisites since it is a prerequisite for ENGR 320.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

Curriculum Proposal
New Course: ENGR 441

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 441 Environmental Engineering (4)
   An introduction to environmental engineering, including: water usage and conservation; water chemistry including pH and alkalinity relationships, solubility and phase equilibria; environmental biology; fate and transport of contaminants in lakes, streams and groundwater; design and analysis of mechanical, physicochemical and biochemical water and wastewater treatment processes. Three hours lecture/discussion and one three hour laboratory per week. Prerequisite or correquisite: ENGR 320 or consent of the instructor.

3. **Resource Implications**. Additional laboratory equipment will be required for this course, and will be purchased from external funding sources. Additional faculty resources will also be required for this course. This extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by one of the faculty members. This class will be offered every other year in the Spring quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 441, Environmental Engineering (4 credits)

Course Description: An introduction to environmental engineering, including: water usage and conservation; water chemistry including pH and alkalinity relationships, solubility and phase equilibria; environmental biology; fate and transport of contaminants in lakes, streams and groundwater; design and analysis of mechanical, physicochemical and biochemical water and wastewater treatment processes. Three hours lecture/discussion and one three hour laboratory per week.

Prerequisite or correquisite:

- ENG 320, Fluid Mechanics

Text: Recommended but not required:

- Environmental Engineering, Fundamentals, Sustainability, Design, James Mihelcic, Julie Zimmerman, Wiley, 2009, ISBN: 978-0-470-16505-8

Course Outcomes: This course requires students to demonstrate the following:

- Describe key concepts in chemistry, biology, hydrology, physics and ecology that are fundamental to environmental engineering.
- Apply the science and engineering principles to the modeling of environmental processes.
- Apply engineering principles to design water/wastewater treatment.

Tentative Schedule:

I. Environmental measurements **1 week**

- Mass Concentration Units.
- Volume/Volume and Mole/Mole Units.
- Partial-Pressure Units.
- Mole/Volume Units.

II. Environmental chemistry **1 week**

- Activity and concentration
- Reaction and Stoichiometry
- Volatilization
- Acid-Base Chemistry.
- Oxidation-Reduction.

III. Physical processes **1 week**

- Mass balances
- Energy balances

IV. Biology in Environmental Engineering **1 week**

- Ecosystems Structure
- Population dynamics
- Oxygen Demand:Biochemical, chemical and theoretical

V Environmental Risk **1 week**

- Hazardous Waste and Toxic Chemicals
- Risk and the Engineer
- Risk assessment

VI Green Engineering **1 week**

- Design
- Pollution Prevention
- Measuring Sustainability

VII Water Quality **1 week**

- River Water Quality
- Wetlands
- Ground Water Quality

VIII Water Supply, Distribution, and Wastewater collection **1 week**

- Water availability
- Water usage

IX Water Treatment **1 week**

- Characteristics of Untreated Water
- Water Quality Standards
- Water Treatment Processes

X Wastewater Treatment **1 week**

- Preliminary treatment
- Secondary Treatment
- Activated-sludge process
- Disinfection and Aeration

Tentative Schedule (laboratory):

- Week 1: Introduction and Safety
- Week 2: pH and Turbidity
- Week 3: Hardness
- Week 4: Optimum coagulant dosage and flocculation

- Week 5: Determination of dissolved oxygen
- Week 6: Biological Oxygen demand
- Week 7: Chemical Oxygen demand
- Week 8: Residual chlorine
- Week 9: Spectrophotometry
- Week 10: Volatile organic compounds

Grades:

Homework Assignments	10%
Laboratory Reports	30%
Midterm exam	30%
Final exam	30%

Curriculum Proposal
New Course: ENGR 442

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 442 Food and Bioprocess engineering unit operations (4)
   Principles of the engineering design, testing and analysis of unit processing operations employed in the food and bioprocess industries, such as sterilization, pasteurization, freezing/refrigeration, drying, evaporation, and fermentation, along with physical, chemical and phase separations. Design and analysis of thermal, freezing, evaporation, dehydration; and mechanical, chemical and phase separations processes as governed by reaction kinetics and rheology of food and biological materials. Three hours lecture/discussion and one three hour laboratory per week. Prerequisites: ENGR 330 or consent of the instructor.

3. **Resource Implications**. Additional laboratory equipment will be required for this course, and will be purchased from external funding sources. Additional part-time faculty resources will also be required for this course. This extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by one part-time instructor. This class will be offered every year in the Winter quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to biological and agricultural engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 442, Food and Bioprocess Engineering Unit Operations (4 credits)

Course Description: Principles of the engineering design, testing and analysis of unit processing operations employed in the food and bioprocess industries, such as sterilization, pasteurization, freezing/refrigeration, drying, evaporation, and fermentation, along with physical, chemical and phase separations. Design and analysis of thermal, freezing, evaporation, dehydration; and mechanical, chemical and phase separations processes as governed by reaction kinetics and rheology of food and biological materials. Three hours lecture/discussion and one three hour laboratory per week.

Prerequisite(s):

- ENG 330, Heat Transfer

Text: Recommended but not required:

- Food & Process Engineering Technology, Luther R. Wilhelm, Gerald H. Brusewitz, Dwayne A. Suter, ASABE, ISBN: 978-1892769435
- Food Process Engineering Technology, Zeki Berk, Academic Press, ISBN: 978-0-12-373660-4
- Unit Operations in Food Engineering, Albert Ibarz, Gustavo V. Barbosa-Cánovas., CRC press, ISBN: 1-56676-929-9
- Virtual book: Unit operations in food engineering, R.L. Earle , http://www.nzifst.org.nz/unitoperations/index.htm

Course Outcomes: This course requires students to demonstrate the following:

- Describe unit processing operations employed in food and agricultural industries.
- Apply the engineering principles to design a unit operation process.
- Estimate the economic feasibility of an unit operation process.

Tentative Schedule:

I. Introduction to Unit Operations **1 week**

- Unit Operations: Classification
- Steady and Unsteady States
- Dimensional Analysis

II. Introduction to Transport Phenomena **1 week**

- Mechanisms of Transport Phenomena
- Mass and Energy Transfer
- Dimensional Analysis

III. Molecular Transport of Momentum, Energy and Mass **1 week**

- Momentum Transfer
- Mass Transfer

IV. Air-Water Mixtures **1 week**

- Properties of Humid Air
- Wet Bulb Temperature
- Adiabatic Saturation of Air

V. Rheology of Food Products **1 week**

- Stress and Strain
- Elastic Solids and Newtonian Fluids
- Viscometric Functions
- Rheological Classification of Fluid Foods
- Newtonian Flow
- Non-Newtonian Flow
- Viscoelasticity

VI. Transport of Fluids through Pipes **1 week**

- Circulation of Incompressible Fluids
- Macroscopic Balance in the Circulation of Fluids
- Mechanical Energy Losses
- Friction Factors
- Design of Piping
- Pumps

VII. Circulation of Fluid Through Porous Beds **1 week**

- Darcy's Law: Permeability
- Equations of Flow through Porous Beds
- Fluidization

VIII. Filtration **1 week**

- Filtration Fundamentals
- Filtration at Constant Pressure Drop
- Filtration at Constant Volumetric Rate

IX. Separation Processes by Membranes **1 week**

- Models of Transfer through the Membrane
- Models of Transfer through the Polarization Layer
- Inverse Osmosis
- Ultrafiltration

X. Thermal Processing of Foods **1 week**

- Kinetics of Thermal Destruction
- Treatment of Packed Products
- Thermal Treatment in the Aseptic Processing
- Freezing Temperature
- Thermal Properties of Frozen Foods

Tentative Schedule (laboratory):

- Week 1: Introduction and Safety
- Week 2: Crystallization, size reduction and sieve separation
- Week 3: Heat exchangers
- Week 4: Spray drying
- Week 5: Rheological Properties of Food
- Week 6: Extrusion
- Week 7: Sedimentation, Filtration and Membrane separation
- Week 8: Centrifugation
- Week 9: Freeze drying
- Week 10: Solvent extraction and distillation

Grades:

Homework Assignments	10%
Laboratory Reports	30%
Midterm exam	30%
Final exam	30%

Curriculum Proposal
New Course: ENGR 452

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 452 Petroleum Production Engineering (4)
   Covers topics in modern petroleum production engineering, including production technologies, production equipment, equipment design and optimization, well completion, tubing design, well performance evaluation (productivity index), inflow performance relationships (IPR), artificial lift and surface facilities. Four hours lecture/discussion per week. Preprequisite: ENGR 351 or consent of the instructor.

3. **Resource Implications**. Only additional part-time faculty resources will be required for this course. The extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by a part-time instructor. This class will be offered every other year in the winter quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to petroleum engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 452, Petroleum Production Engineering (4 credits)

Course Description Covers topics in modern petroleum production engineering, including production technologies, production equipment, equipment design and optimization, well completion, tubing design, well performance evaluation (productivity index), inflow performance relationships (IPR), artificial lift and surface facilities. Four hours lecture/discussion per week.

Prerequisite(s):

- ENGR 351, Fundamentals of Petroleum Engineering and Transport through Porous Media

Text: Recommended but not required:

- Production Operations, volumes I and II, by Allen, T.O. and Roberts, A.P., 5th Edition, PennWell, 2008.
- Production Optimization Using NODAL Analysis, by Beggs H.D., Oil and Gas Consultants International, 2nd Edition (2008)

Course Outcomes: This course requires students to demonstrate the following:

- Select and design production equipment, including well completion
- Evaluate well performance
- Define relationships in well performance across a reservoir

Tentative Schedule:

I.	Introduction to petroleum production	0.5 weeks
II.	Well Completion • Effects of reservoir characteristics on well completion design • Tubing string design • Packer design • Subsurface control equipment	1 weeks
III.	Well Performance • Evaluation of well performance • Productivity Index • Inflow performance relationship (IPR curves)	1 weeks
IV.	Multi-Phase Flow in production wells, horizontal and vertical	1.5 weeks
V.	Flowing oil and gas wells, design and evaluation	1.5 weeks
VI.	Artificial Lift Systems • Equipment Design and evaluation (gas lift, rod pumping, etc)	1 week
VII.	Surface Facilities • Design and operations (gathering systems, pipelines, separators)	1.5 week
VII.	Production Logging	1.5 weeks

- Tools for production logging, techniques and analysis procedures

VII. Workover procedures and Stimulation 1 week

- Workovers design (cement squeeze, recompletions, etc)
- Fracture/ Acidizing treatments design and execution

VII. Nodal Analysis 1.5 weeks

Grades:		
	Class Participation	10%
	Homework Assignments	10%
	Midterm exam	40%
	Final exam	40%

Curriculum Proposal
New Course: ENGR 453

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 453 Reservoir Engineering (5)
   Fundamental equations of fluid flow through porous media, reservoir material balances, aquifer influx, well testing, and decline curve analysis. Methods for forecasting reservoir performance are covered using analytical models. Five hours lecture/discussion per week. Preprequisites: MATH 203 or 233, and ENGR 351, or consent of the instructor.

3. **Resource Implications**. Only additional part-time faculty resources will be required for this course. The extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by a part-time instructor. This class will be offered every other year in the spring quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to petroleum engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 453, Reservoir Engineering (5 credits)

Course Description: Fundamental equations of fluid flow through porous media, reservoir material balances, aquifer influx, well testing, and decline curve analysis. Methods for forecasting reservoir performance are covered using analytical models. Five hours lecture/discussion per week.

Prerequisite(s):

- MATH 203, Calculus III or MATH 233, Calculus III for Engineering Sciences
- ENGR 351, Fundamentals of Petroleum Engineering and Transport through Porous Media

Text: Recommended but not required:

- "Applied Petroleum Reservoir Engineering, Craft, B. C., Hawkins, M. F. Jr. & Terry, R.E.: Second Edition, Prentice-Hall, 1991.
- Tarek Ahmed, Reservoir Engineer Handbook, 2000/2006 Gulf Professional Publishing, ISBN 13: 978-0-7506-7972-5. Elsevier Inc
- Fundamental Principles of Reservoir Engineering, Towler, b., 2002, 232 pp. Softcover, SPE Textbook series Vol. 8, ISBN:978-1-55563-092-8, Society of Petroleum Engineers
- Dake, L.P.: Fundamentals of Reservoir Engineering, First Edition, Elseveir, 1978

Course Outcomes: This course requires students to demonstrate the following:

- Describe the basic performance characteristics of various reservoir types.
- Describe methods used to exploit oil and natural gas reservoirs
- Design and predict the performance of reservoirs under different producing mechanisms
- Interpret performance characteristic curves for each reservoir type.
- Perform material balance analyses of volumetric oil and gas reservoirs and water influx.
- Diagnose natural reservoir decline trends and perform a decline curve analysis.

Tentative Schedule:

I. Basic Concepts — 1 weeks
   - Reservoir Classification
   - Fluid and Rock Properties

II. Fundamentals of Fluid Flow in Reservoirs — 1.5 weeks
   - Steady-State Flow
   - Transient Flow
   - Pseudosteady-State Flow

III. Well Testing — 1.5 weeks
   - Drawdown test
   - Buid-up test

IV. Material Balances — 3 weeks
   - General Material Balance Equation
   - Oil Reservoirs

- Gas Reservoirs
- Water Influx

V. Reservoir Performance Prediction 3 weeks
- Oil Reservoirs - Solution Gas Drive
- Gas Reservoirs – (p/z method)
- Buckley-Leverett Displacement
- Empirical Methods, Decline Curves
- Presentations / Reservoir Simulation Overview

Grades:		
	Class Participation	10%
	Homework Assignments	10%
	Midterm exam	30%
	Final exam	30%
	Final project: NG reservoir/Field development	20%

Final Project

There will be an individual or team project comprising a reservoir engineering topic or an in-depth solution of a prescribed reservoir engineering problem. Project might involve forecasting the performance of a gas or oil reservoir and will be due on the last day of class. A written report or comprehensive presentation is required for successful completion of the course.

Curriculum Proposal
New Course: ENGR 454

1. **Approval**. Please see cover letter from the Chair of Physics and Engineering.

2. **Proposed Changes**. In this case, adding a catalog description for a new course:

   ENGR 454 Drilling Engineering and Completion Technology (5)
   Fundamentals of drilling equipment, engineering design calculations, wellbore diagrams, drilling fluids, cement calculations, and casing design. Additional topics such as directional drilling as well as completion technologies are covered using practical examples and field applications as applied in the oil and natural gas well drilling operations. Four hours lecture/discussion and one three-hour laboratory per week. Prerequisites: ENGR 244, and 351, or consent of the instructor.

3. **Resource Implications**. Additional laboratory equipment will be required for this course, and will be purchased from external funding sources. Additional part-time faculty resources will also be required for this course. This extra cost will be initially funded by external funding sources. After that runs out, it will be funded by new FTES. The department will not need to make changes to other areas of the curriculum to accommodate teaching this course. It will be taught by a part-time instructor. This class will be offered every other year in the winter quarter.

4. **Curriculum Implications**. This is one of the elective courses in the program in Engineering Sciences.

5. **Rationale**. The intended audience would consist of students majoring in Engineering Sciences. This course is useful to students interested in practical issues related to petroleum engineering. The proposed course does not duplicate any other part of the curriculum.

6. **Request for Approval New Course/Course Changes**. Please see form attached.

ENGR 454, Drilling Engineering and Completion Technology (5 credits)

Course Description: Fundamentals of drilling equipment, engineering design calculations, wellbore diagrams, drilling fluids, cement calculations, and casing design. Additional topics such as directional drilling as well as completion technologies are covered using practical examples and field applications as applied in the oil and natural gas well drilling operations. Four hours lecture/discussion and one three-hour laboratory per week.

Prerequisite(s):

- ENGR 244, Material Science
- ENGR 351, Fundamentals of Petroleum Engineering and Transport in Porous Media

Text: Recommended but not required:

- "Applied Drilling Engineering, by A.D. Bourgoyne Jr., M.E. Chenevert, K.K. Millheim, and F.S. Young Jr., SPE Textbook Series, Vol.2, (1986).
- Drilling Engineering, A Complete Well Planning Approach, by N.J. Adams, PennWell, (1985).
- Practical Well Planning and Drilling, by S. Devereaux, PennWell, (1998).
- Horizontal Wells, by R. Aguilera et. al.,Gulf Publishing, (1991).
- Introduction to Directional and Horizontal Drilling, by J.A. Short, PennWell, (1993)
- Underbalanced Drilling Manual, by Gas Research Institute, (1997).

Course Outcomes: This course requires students to demonstrate the following:

- Describe drilling engineering concepts in oil and natural gas reservoir exploitation
- Evaluate rotary drilling system components for oil and gas drilling.
- Calculate pressure drops based on flow regimes and fluid rheology for estimating pump pressure requirements.
- Evaluate subsurface pressures and rock strengths to design a well through safe and economic casing string.
- Calculate the mud weights required to safely drill a well.
- Optimize the drilling rate.

Tentative Schedule (Lecture):

I. Introduction and Basic Concepts — 0.5 week
   a. History of drilling
   b. Geological considerations
   c. Land management
   d. Regulatory compliance

II. Drilling Rig Design — 0.5 week
   a. Rotary drilling and rig components
   b. Drill string design and bit selection and evaluation

III. Drilling Fluids — 1 week
   a. Types, functions and properties of drilling fluids
   b. Mud calculations and solids control

IV. Drilling Hydraulics Design — 1 week
- a. Pressure loss calculations
- b. Hydraulics and jet bit nozzle design

V. Formation Pore Pressure and Fracture Gradients — 1 week
- a. Pressure relationships in formations
- b. Methods for estimating pore and fracturing pressures

VI. Down-Hole Pressure — 1 week
- a. Blowout detection
- b. Kill methods

VII. Casing Design — 1.5 weeks
- a. Casing types and specifications
- b. Casing performance properties
- c. Casing design criteria
- d. Special design considerations

VIII. Cement Design — 1.5 weeks
- a. Composition of cement and cement additives
- c. Cementing equipment
- d. Cement placement techniques
- e. Plugging and squeeze cementing design

IX. Introduction to Directional Drilling — 1 week
- a. Planning the directional well trajectory
- b. Horizontal wells

X. Special Completion Technologies — 1 week

Tentative Schedule (laboratory):

Week 1: Introduction and Safety
Week 2: Hydration of clay minerals
Week 3: Viscosity of Fresh Water Based Muds / Mud Weight Control
Week 4: Filtration Studies
Week 5: Thinning Agents
Week 6: Chemical Contaminants
Week 7: Red Lime Muds / Polymer Muds
Week 8: Rheological Properties of Muds
Week 9: Salt Water Based Muds
Week 10: Chemical Analysis

Grades:

Class Participation	10%
Laboratory Work and Reports	20%
Homework Assignments	10%
Midterm exam	20%

Final exam		20%
Final project:	Drilling program design	20%

Final Project

There will be an individual or team project comprising a drilling program to include a wellbore diagram, drilling fluids selection, casing design, cement calculations, and directional plot. Project might involve collection of real field data from an oil or gas reservoir in San Joaquin Valley and is due on the last day of class. A written report or comprehensive presentation is required for successful completion of the course.