

MECHANICAL ENGINEERING PROGRAM
ABET COURSE SYLLABUS

ME 436: Petroleum Production Engineering (4) Elective

Course Description: (2013-15 Catalog)	Design, operation and maintenance of surface equipment required in oil production. Processes and systems involved are rod pumping, acidizing, gas lifting, acidizing, hydraulic fracturing, fluid gathering and storage, separation of oil, gas, water and sediment from produced fluid. Includes equipment used in enhanced oil recovery. 4 lectures.
Prerequisite Courses:	ME 329, ME 347
Prerequisites by Topic:	ME 329, Intermediate Design. ME 347, Fluid Mechanics II.
Textbook: (and/or other required material)	<u>Petroleum Production Systems</u> , by M. J. Economides, A. D. Hill and C. Ehlig-Economides, Ding Zhu, Prentice Hall, 2014. <u>Well Design: Drilling and Production</u> , by Craft, Holden and Graves, Jr. Prentice Hall, 1962.
References:	<u>Surface Production Operation</u> , Vol. 1, <u>Design of Oil-Handling Systems and Facilities</u> , by K. Arnold and M. Stewart, Gulf Publishing Company, March 1991. <u>Petroleum Geology</u> , Petroleum Extension Services, 1991
Course Coordinator/Instructor:	M. Medizade, Professor of ME
Course Learning Outcomes:	<ol style="list-style-type: none">1. Describe petroleum geology,2. Describe and analyze fluid flow from reservoir into the well in oil, and gas reservoirs,3. Design horizontal well for oil and gas productions,4. Design complete rod pump unit,5. Design complete gas lift unit,6. Calculate well inflow curves and skin factors,2. Design a system for vapor recovery and pollution control,3. Design production systems for gas, condensate, oil and water,4. Design gravel pack and analyze sand control methods,6. Design a fracture job and an acid job,7. Describe design specifications for separation and treatment of produced fluids.

Relationship of Course to MECHANICAL ENGINEERING Program Outcomes:												
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>
H	M	M	M	H	L	H	M	M	M	H	H	H

**Topics Covered:
(recommended number of
hours each)**

1. The Role of Petroleum Production Engineering

Components of the petroleum production system, Well productivity and production engineering, Units and conversions, Petroleum Geology

2. Production from Under-saturated Oil Reservoirs,

steady state well performance, transient flow of under-saturated oil, pseudo-steady state flow, transition to pseudo-steady state from infinite acting behavior, wells draining irregular patterns, inflow performance relationship, effects of water production, relative permeability, summary of single phase oil inflow performance relationships

3. Production from Two Phase Reservoirs,

properties of saturated oil, two phase flow in reservoir, oil inflow performance for a two phase reservoir, generalized Vogel inflow performance, Fetkovich's approximation

4. Production from Natural Gas Reservoirs,

gas gravity, real gas law, correlations and useful calculations for natural gases, approximation of gas well deliverability, gas well deliverability for non - Darcy flow, transient flow of a gas well.

5. Production from Horizontal wells,

Steady state well performance, pseudo-steady state flow, inflow performance relationship for horizontal gas wells, two phase correlations for horizontal well inflow, multilateral well technology.

6. The Near Wellbore Condition and Damage

Characterization: Skin Effects, Hawkins formula, skin components for vertical and inclined wells, skin from partial completion and well deviation, horizontal well damage skin effects, well completion skin factors, formation damage mechanisms, sources of formation damage well operations

7. Sand Management,

sand flow modeling, sand management, sand exclusion, completion failure avoidance.

8. **Sucker Rod Pumping:** Subsurface pump, sucker rod string, surface pumping equipment, prime mover, theoretical analysis of rod motion, effective plunger stroke, calculation of polished rod loads, design of the sucker rod string, pump displacement and production rate, counterbalance design, calculation of torque, speed reduction from prime mover to crankshaft, power requirements of the prime mover, summary of design equations, steps in the design of a pumping installation, factors in sucker rod and tubing failure, use of the recording dynamometer in well analysis, interpretation of a dynamometer card, applications of dynamometer cards, problem well testing, and determination of pumping efficiencies.
9. **Gas Lift:** Application, valve mechanics, design of a continuous-flow gas-lift system, intermittent flow.
10. **Fluid Separators:** Oil and gas separators (two phase and three phase), heater treaters, oil skimmers.
11. **Hydraulic Fracturing:** Inducing fractures, productivity ratio, fracture area, fracturing fluid coefficients, fracture efficiency, fracturing hydraulics, fracture design calculation.
11. **Acidizing:** Types of treatments, acid-fracturing design.
12. Water Treating and Water Quality
Vapor Recovery

Laboratory Projects: None

Class/Lab Schedule: Four 50-minute lectures per week.

Contribution of Course to Meeting the Professional Component:	(a) College-level mathematics and basic sciences:	0 credits
	(b) Engineering Topics: Design	3 credits Yes, 1 unit
	(c) General Education:	0 credits
	(d) Other:	0 credits

Prepared by: M. Medizade

Date: 6/10/2014
