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Energy (ENER) 1520 Introduction to Petroleum Engineering (3 Units) CSU

Advisory: Eligibility for Math 1060 and English 1500 strongly recommended

Total Hours: 48 hours lecture

Catalog Description: This course is a comprehensive introduction to the engineering and business challenges that pertain to the exploration and production of oil and natural gas. The course addresses the many fundamental topics within the main sub-disciplines of Petroleum Engineering: reservoir, drilling, production and operations, facilities, and project economics. Fieldtrips may be required.

Type of Class/Course: Degree Credit

Text: Leffler, William and M. Raymond. *Oil and Gas Production in Nontechnical Language*. Tulsa, OK: Pen Well Corporation, 2006. Print.

Course Objectives:

By the end of the course a successful student will be able to:

1. demonstrate an understanding of the fundamental theories, principles, and practices in reservoir engineering, production and operations engineering, drilling engineering, and facilities engineering,
2. demonstrate an understanding of the theories, principles, and practices associated with project economics in petroleum engineering systems,
3. demonstrate foundation knowledge of petroleum engineering to further education and career options.

Course Scope and Content (Lecture):

- Unit I Introduction
- A. Engineering disciplines: petroleum, mechanical, chemical, civil, electrical, others
 - B. Units of measurements and dimensional analysis
 - C. Oilfield units of measurements
 - D. Significant digits. Precision versus accuracy

- Unit II Petroleum Industry Overview
- A. Downstream: oil refining, petrochemical manufacturing, retailing
 - B. Midstream: transporting oil, natural gas, and petroleum liquids
 - C. Upstream: exploration and production of oil and natural gas

- Unit III Petroleum Geology
- A. Geologic time, plate tectonics, minerals and rock types
 - B. Origin, formation, and migration of oil and natural gas
 - C. Depositional environments; basins of California
 - D. Reservoirs: structural and stratigraphic traps
 - E. Subsurface mapping. Cross-sections

- Unit IV Reservoir Fluids
- A. Hydrocarbon types; chemical and structural formulas of hydrocarbons
 - B. Equations of state: Boyle's, Charles', Avogadro's equations, ideal and real gases
 - C. Phase behavior: bubble point, dew point, critical point
 - D. Petroleum fluid categories: black oil, volatile oil, retrograde gas, wet gas, dry gas
 - E. Viscosity, specific gravity, volume factors, compressibility
- Unit V Reservoir Rock Properties
- A. Rock mechanics parameters: stress, strain, Poisson's Ratio, Young's Modulus
 - B. Conventional and special core analysis
 - C. Porosity, compressibility
- Unit VI Reservoir Rock and Fluid Relationships
- A. Fluid saturations
 - B. Wettability, capillary pressure
 - C. Darcy flow equation. Absolute, effective, and relative permeability
- Unit VII Well Logs and Formation Evaluation
- A. Electric Logs: SP, resistivity, dip meter. Fluid saturation determination
 - B. Radioactivity Logs: gamma ray, neutron, density
 - C. Sonic logs and determination of rock properties
 - D. Production Logs
- Unit VIII Exploration Methods
- A. Magnetic and gravity surveys
 - B. Seismic surveying and evaluation
 - C. Exploration Drilling
- Unit IX Drilling
- A. Rig components and systems
 - B. Fluids, cements, bits
 - C. Pressure and temperature gradients
 - D. Mud logging, drill stem tests, formation tests, coring
 - E. Casing installation
 - F. Directional drilling methods and tools
- Unit X Well Completions, Recompletions, and Repairs
- A. Perforating, hydraulic fracturing, acidizing
 - B. Coil tubing operations
 - C. Tubing, packers, plugs, cement squeezes
 - D. Plugging and Abandoning
- Unit XI Oil and Gas Recovery Methods
- A. Primary drive mechanisms: volumetric, solution gas, water, gas cap
 - B. Secondary and enhanced oil recovery methods: steam, water, and CO₂ flooding
- Unit XII Artificial Lift Methods
- A. Rodlift: pumping unit components, rods, pumps
 - B. Gaslift. ESP's
 - C. Progressive Cavity Pumps

- Unit XIII Production Facilities
- A. Separators: two phase, three phase, vertical, and horizontal. Free water knockouts
 - B. Dehydration: heater treaters, glycol reboilers
 - C. Production flowlines, liquid and gas gathering piping
 - D. Corrosion control, emulsion treating, hydrate formation and control
 - E. Natural gas compression and gas treatment plants
 - F. Measurement and metering, storage, water disposal
- Unit XIV Economic Evaluation of Petroleum Projects
- A. Land management terms: WI, NRI, primary term, lease bonus, royalty terms
 - B. Discounting and Time Value of Money
 - C. Financial terms and metrics: capex, opex, NPV, IRR, PI, Payout
 - D. Evaluation of multiyear projects
 - E. Reserves classifications: proved, unproved, contingent resources
 - F. Reserves estimation methods: in place volumes and recovery factors, volumetric, DCA, material balance

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 hours per week outside of the regular class time doing the following:

1. Studying assigned text, handout materials and class notes
2. Reviewing and preparing for quizzes, midterm and final exams
3. Completing group projects

Methods of Instruction:

1. Lecture and discussions
2. Group activities/projects
3. Field trips (oil and gas production activities)

Methods of Evaluation:

1. Quizzes
2. Exams
3. Participation
4. Individual and group exercises & projects

Supplemental Data:

TOP Code:	095430: Petroleum Technology
SAM Priority Code:	C: Clearly Occupational
Distance Education:	Not Applicable

Funding Agency:	Y: Not Applicable(funds not used)
Program Status:	1: Program Applicable
Noncredit Category:	Y: Not Applicable, Credit Course
Special Class Status:	N: Course is not a special class
Basic Skills Status:	N: Course is not a basic skills course
Prior to College Level:	Y: Not applicable
Cooperative Work Experience:	N: Is not part of a cooperative work experience education program
Eligible for Credit by Exam:	NO
Eligible for Pass/No Pass:	NO
Taft College General Education:	NONE