fluid flow measurements.

3053 Petroleum Engineering Aspects of Subsurface Geology (3) V Prereq.: PETE 3035 and 3036; or senior status in geology. Engineering aspects of petroleum geology; interpretation of subsurface data; reservoir mapping; determination of reservoir characteristics; and methods used in correlation of subsurface data.

3990 Independent Research (1-3) F,S,Su May be taken for a max. of 3 sem. hrs. of credit. Students should contact advisor at least 1 week prior to registration. Individual research or engineering studies with faculty supervision.

4045 Drilling Engineering (3) V Prereq.: PETE 4060, CE 2200 and credit or registration in CE 3400. Drilling process, including equipment and performance; well pressure control; reservoir characterization; calculation of pressure; and optimum hydraulic driftings of drilling fluids; oil well casing design and cementing techniques.

4046 Well Design-Production (3) V Prereq.: PETE 4045, CE 2460 or ME 3333, and CE 3400. Analysis and design of well production systems; rod pumping, gas lift.

4050 Reservoir Dynamics (3) V Prereq.: PETE 2032, ME 3333 and MAT 2065. Fundamentals of reservoir flow; application to single-well performance; well testing; gas reservoir engineering; waterflooding fundamentals.

4051 Reserve Estimation and Reservoir Management (3) V Prereq.: PETE 3025, 3053, and IE 3302. Quantitative study and behavior prediction of volumetric and water-drive reservoir systems in order to maximize ultimate recovery.

4056 Numerical Simulation of Improved Recovery Processes (3) S Prereq.: MATH 2053, and PETE 4050 and 4051. First phase of research to predict and optimize oil and gas reservoir performance and to design enhanced recovery processes.

4058 Reservoir Mechanics Laboratory (1) S Prereq.: PETE 4051. 3 hrs. lab. Simulation of reservoirs with physical models; fluid flow in porous media.

4059 Drilling Engineering Laboratory (1) V Prereq.: credit or registration in PETE 4045. 3 hrs. lab. Accompanies PETE 4045.

4060 Prevention of Oil and Gas Well Blowouts (1) S Prereq.: CE 2200. 3 hrs. lab. Causes and detection of well kicks and the proper handling of these kicks to prevent uncontrolled flow of drilling fluids; well management and techniques currently used in the oil and gas industry.

4062 Secondary Recovery of Petroleum (3) V Prereq.: PETE 4059 or equivalent. Theory and practice related to miscible displacement processes and chemical and polymer flooding techniques.

4072 Drilling Data Acquisition and Processing (3) V Prereq.: PETE 4050, 4060, and 4066 or equivalent. Mud and surface data acquisition; dynamic, steady state and multiphase data acquisition with drilling stopped and while drilling; data processing; formation evaluation and data analysis.

4073 Downhole Testing (3) V Prereq.: PETE 4057 and 4058. Wireline sidetrack core and fluid recovery; data analysis and completion techniques; thermodynamic properties of fluids; downhole production data acquisition and interpretation; cased hole formation evaluation.

7211 Production System Analysis (3) V Prereq.: PETE 4050 or 4056 or equivalent. Use of multiphase flow correlations to determine flow rates and pressure traverses in flowing oil wells, gas-condensate wells, gathering systems, and pipe lines; applications of correlations to the design of gas lift systems.

7212 Well Completion Design (3) V Prereq.: PETE 4046 or consent of instructor. Systems analysis for optimum production design by best combination of tubing, flow lines, choke sizes, perforation density, and separator pressure; inflow performance of reservoirs; well completion techniques; and methods of completion systems. Special emphasis on forecasting production performance, including multiphase flow processes.

7221 Drilling Fluid Data Acquisition and Processing (3) V Prereq.: PETE 4050, 4050, and 4066 or equivalent. Mud and surface data acquisition; dynamic, steady state and multiphase data acquisition with drilling stopped and while drilling; data processing; formation evaluation and data analysis.

7222 Statistics for Downhole Testing (3) V Prereq.: PETE 4050, 4057 and 4058. Statistical analysis of downhole data; interference; reservoir simulations; well production; production/facilities problems; reservoir simulation models.

7223 Thermal Methods of Oil Recovery (3) V Theory and field practice related to miscible displacement processes and chemical and polymer flooding techniques.

7231 Nonthermal Methods of Enhanced Oil Recovery (3) V Theory and practice related to miscible displacement processes and chemical and polymer flooding techniques.

7232 Thermal Methods of Oil Recovery (3) V Theory of heat transfer and application to the performance prediction of oil recovery by such field processes as forward and reverse in situ combustion, continuous and cyclic hot fluid injection, and production well heating.

7241, 7242 Selected Topics in Advanced Petroleum Engineering (3,3) V May be repeated for credit when topic varies. A total of 12 sem. hrs. of credit may be earned in these two courses.

7256 Special Problems in Petroleum Engineering (1-6) S,F,Su May be taken for a max. of 9 sem. hrs. of credit. Individual study and research.

7280 Mathematical Simulation of Petroleum Reservoir Performance (3) V Prereq.: PETE 4050 or equivalent; and PETE 4050 and 4051. Development and application of mathematical models for predicting petroleum reservoir performance, including multiphase flow field in three dimensions.

7285 Statistical Reservoir Modeling (3) Prereq.:

- senior or graduate standing in petroleum engineering; introduction to basic concepts and design of reservoir simulation models. Special emphasis on uncertainty modeling; spatially variable rock properties for subsurface reservoirs; distribution, transforms, Bayesian updating, variances/correlograms, estimation and coestimation with various kringing methods, conditional simulation.

7999 Seminar (1) All graduate students are expected to attend this course every semester. Only 1 sem. hr. of credit will be allowed toward the degree. Pass/Fail grading.

8000 Thesis Research (1-12 per sem.) S,Y,U grading.

9000 Dissertation Research (1-12 per sem.) S,Y,U grading.

PHILOSOPHY • PHIL

General education courses are marked with stars (*).

*1000 Introduction to Philosophy (3) Credit will not be given for both this course and PHIL 1001. Major works on such themes as appearance and reality, human nature, nature of knowledge, mind and body, right and good, existence of God, and freedom and determinism.

*1001 HONORS: Introduction to Philosophy (3) Same as PHIL 1000. Particularly designed for qualified students. Credit will not be given for both this course and PHIL 1000.

*1003 Introduction Logic (3) No special background presupposed. Formal and informal reasoning; introduction to propositional logic; formal and informal fallacies; scientific reasoning.

2000 Contemporary Moral Problems (3) Philosophical study of contemporary moral problems such as capital punishment, preferential treatment, sexual equality, sexual liberation, abortion, war and peace,人人, world hunger, environmental ethics, and the morality of suicide.

2010 Symbolic Logic I (3) Classical propositional and first-order predicate logic; syntax and semantics of formal languages; translation between formal languages and English. Additional topics as time permits.

2018 Professional Ethics (3) Special problems of obligation and valuation related to law, medicine, politics, and education; as well as business, engineering, and architecture; altruism, trust, vocation, codes of honor, professional privilege, and responsibilities for others arising from such relationships.

2020 Ethics (3) Classical and recent theories of obligation and value, including works of philosophers such as Plato, Aristotle, Kant, Hume, and Nietzsche; topics including freedom, rights, justification of moral judgments.

2021 Environmental Ethics (3) Ethical relations to other humans through the environment and to non-humans within the environment. Topics may include: animal rights, the intrinsic value of nature, deep ecology, climate change, and potential future technologies.

2023 Philosophy of Art (3) Philosophical theories of beauty, art, and art criticism.

2042 Philosophy in Literature (3) Philosophical themes in world literature: fiction, poetry, drama, and autobiography.

2052 Bioethics (3) Defining health and disease; deciding on abortion and other full and partial birth terminations; the human relationship; abortion and the concept of a person; defining and determining death, euthanasia and the dignity of death; surface medical research; organ or tissue harvesting; downdrug; small-scale experimentation with fetuses, children, prisoners, and animals; genetic testing, screening, Selection.

2088 Philosophy of Religion (3) Same as REL 2028. Essence and meaning of religion as a pervasive phenomenon in human societies; faith and reason, nature of the divine, arguments for and against God's existence, religious knowledge and experience, morality and cult, the problem of evil.

2033 History of Ancient and Medieval Philosophy (3) An honors course, PHIL 2034, is also available. Introduction to philosophy through the study of some of the main writings of classical and medieval philosophy.

2034 HONORS: Tutorial in Ancient and Medieval Philosophy (3) An honors course, PHIL 2035, is also available. Introduction to philo-

2035 History of Modern Philosophy (3) An honors course, PHIL 2035, is also available. Introduction to phi-

2036 HONORS: Tutorial in Modern Philosophy (1) To be taken concurrently with PHIL 2035. 1 hr. of tutorial instruction per week for honors students.

2037 History and Problems of Science and Medicine (3) Prereq.: one course in philosophy, HNRS 1001/1003 or 2002/2004, or permission of instructor. Same as REL 2037. Option with a special honors section for qualified students. Supervised reading, discussion, research, and writing.

2500 Knowledge and Reality (3) Introduction to critical epistemological and metaphysical questions: mind and matter; causation and free will; space and time; meaning and truth; the nature of knowledge and justified belief; perception, memory, reasoning, and testimony as sources of knowledge and justified belief.

2786 Logic, Science, and Society (3) Prereq.: completed analytical reasoning area of general education or consent of instructor. Logic, evidence, probability, and induction; objectivity and relativism; technology and utopia.

2953 HONORS: Philosophical Colloquium (3) Prereq.: a grade of "B" or higher in at least one other philosophy course; or consent of instructor. Subject drawn from premier philosophical works.

2956, 2964, 2965 HONORS: Independent Work for Honors Students (1,1,1) Prereq.: sophomore standing, completion of at least 1 hr. of work at the grade of "B" or higher, and a gpa of at least 3.0 in all work taken. Readings, conferences, and reports under faculty direction.

3003 French Existentialism (3) Basic themes of existentialism: philosophy; the works of Kierkegaard, Nietzsche, Jaspers, Heidegger, Camus, Marcel, and Sartre.

3004 Logic, Science, and Society (3) Prereq.: completed analytical reasoning area of general education as philosophical texts.

3003 French Existentialism (3) Major themes, issues, and applications of French existentialist thought; essence, and the question of Being; death, nothingness, and anxiety; freedom, responsibility, and values; the ethical and the other.

authors include Jean-Paul Sartre, Simone de Beauvoir, Maurice Merleau-Ponty, Albert Camus.

314 Petroleum Engineering
PHYSICS

Prerequisites • All prerequisites in physics courses should be rigidly observed.

Corequisites • A student may not continue in a course after dropping a prerequisite course prior to the last day of the midsemester examination period.

Of the 7000-level courses, those numbered in the 7200s, as well as 7434, 7363, 7383, 7398, and 7411 are offered every year in 2000, 2001, 2002, 2003, and 2004. Other courses are offered sporadically as interest demands and in order to provide a varied curriculum.

General education courses are marked with stars (★).

1100 Introduction to Physics (3) Prereq.: credit or registration in MATH 1505. Measurement, vectors, kinematics, Newton's laws of motion, wave motion, temperature, the electric circuit, DC circuits, analysis of motion, magnetism, and wave phenomena.

★ 2001, ★ 2002 General Physics (3, 3.3) Prereq. for PHYS 2001: MATH 1022 or 1023; Prereq. for PHYS 2002: PHYS 2001. 3 hrs. lecture/3 hrs. lab. Credit will not be given for these courses and PHYS 2102, 2103, 2101, 2102. Fundamentals of classical and modern physics; calculus and vector analysis introduced and used in development of subject matter.

2108 General Physics Laboratory for Physics Majors 1 Prereq.: Credit or registration in PHYS 2101. Prereq. for PHYS 2102: credit or registration in PHYS 2101. Prereq. for PHYS 2109: 3 hrs. lab. Credit will not be given for these courses and PHYS 2102, 2101, 2102. Mechanics, heat, sound, light, electricity, and magnetism; topics in modern physics.

2109 General Physics Laboratory for Non-Majors 1 Prereq.: Credit or registration in PHYS 2101. Credit will not be given for this course and PHYS 2102, 2101, 2102. Laboratory to accompany PHYS 2101 or 2102.

2111 Elementary Mathematical Physics (3) F Prereq.: PHYS 2102 or; and credit in MATH 1552. Mathematical methods of physics; vector calculus, complex variables, Fourier series, matrices and determinants, differential equations with application to selected problems in physics.

2203 Introductory Modern Physics (3) F Prereq.: PHYS 2102 or 2101. Elementary modern physics: special and general relativity, wave-particle duality, quantum mechanics, hydrogen atom, many-electron atoms, nuclear structure, elementary particles, solid state, astrophysics, and cosmology.

2207 Introductory Modern Physics Laboratory (1) F Coreq.: PHYS 2203. Required for physics majors. Laboratory to accompany PHYS 2203.