UNIVERSITY OF HOUSTON

Department of Chemical Engineering

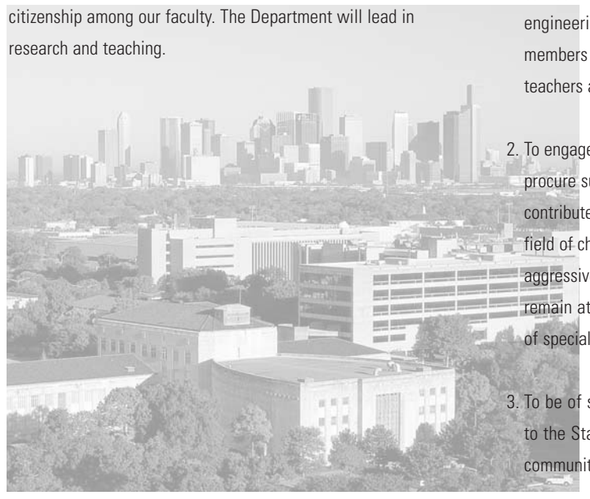
2001 – 2002 ANNUAL REPORT

INTRODUCTION

This Annual Report describes the activities and accomplishments of the Chemical Engineering Department at the University of Houston during the 2001–2002 academic year. Information is provided regarding Departmental activities spanning education and research.

VISION STATEMENT

The Department will regain international prominence within five years, through leadership in three core research areas and our graduating students becoming leaders in the field. The Department will create the highest level of enthusiasm, collegiality, and citizenship among our faculty. The Department will lead in research and teaching.



MISSION STATEMENT

1. To provide a high-quality education for undergraduate and graduate Chemical Engineering students through a comprehensive curriculum that emphasizes basic science, mathematics, engineering science, and engineering design. UH ChE faculty members are expected to maintain their reputations as superior teachers and to provide a stimulating educational environment.

2. To engage in research programs that train graduate students, procure support for this research on a continuous basis, and contribute to the development of fundamental knowledge in the field of chemical engineering. Our Department's varied and aggressively pursued research ensures that our faculty members remain at the technological forefront of their respective areas of specialization.

3. To be of service to the community at large and, in particular, to the State of Texas, and to provide the local engineering community opportunities for advanced and continuing education.

A special thanks to Mr. Toban Dvoretzky for compilation of this Report, as he has done in stellar fashion on a regular basis since he conceived and produced the inaugural issue in 1992.

Prepared by the University of Houston Department of Chemical Engineering, Toban Dvoretzky

Produced by the UH Cullen College of Engineering Office of Communications, Harriet Yim, Angie Shortt

UNIVERSITY OF HOUSTON
Cullen College of Engineering
Department of Chemical Engineering

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CHAIRMAN'S SUMMARY

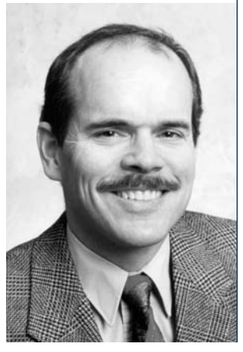
This is the 2001–2002 Annual Report of the University of Houston Department of Chemical Engineering. In it, we provide a snapshot of the current state of the department, highlighting the past year's accomplishments.

The department is in the midst of an ambitious period of growth. This past year, we have hired two new faculty members. Dr. Vincent M. Donnelly, a renowned expert in the area of plasma science and engineering with applications in microelectronics, is our newest Professor as of Fall 2002. Vince was most recently a Distinguished Member of the Technical Staff of Agere Systems, Inc. (formerly Lucent Technologies and AT&T Bell Laboratories) in Murray Hill, NJ. Dr. Donnelly earned his B.A. in Chemistry from LaSalle College (Philadelphia) in 1972, and his PhD in Physical Chemistry from the University of Pittsburgh in 1977.

Dr. Adam Capitano is our newest Assistant Professor. Adam joins us from MIT where he was a postdoctoral researcher. Adam earned his B.S. in Chemistry from the University of Iowa (1994) and his PhD in Chemistry from the University of Michigan (1999). Adam brings to the Department a unique combination of expertise—he holds the distinction of having completely and successfully changed his research focus from surface science of reaction systems to biological systems.

The department is doing very well in spite of this period of tremendous change for the field of chemical engineering. Undergraduate enrollments are stabilizing while graduate enrollments are growing. The research programs of our faculty are very healthy, with a strong surge in research support. The faculty continue to be extremely productive in terms of scholarly activities such as invited lectures and peer-reviewed publications.

We look forward to continuing to grow and thrive as a department. I invite you to review this report, and I hope that you find it informative. We look forward to any feedback that you may have.



Michael Harold
Dow Chair Professor
& Department Chair

STRATEGIC PLAN
DEPARTMENT OF CHEMICAL ENGINEERING

Long-Range Goals

Overall Program
» Sustain top ranking among Chemical Engineering Departments.
» Grow the Chemical Engineering Department to at least 20 full-time, research-active faculty with improved diversity (women and minorities).
» Establish stronger industrial interactions, especially with companies in the greater-Houston area.
» Improve infrastructure and facilities to promote scholarly research.

Graduate Program
» Increase scholarly output and recognition in terms of doctoral students, publications, invited lectures, and awards.
» Improve the quality of incoming graduate students.
» Establish three research centers of excellence that involve at least three Chemical Engineering faculty members in each. These centers should attract major funding from industrial and governmental sources. The centers are key to enhancing the external visibility and reputation of the Department.
» Increase the number and percentage of domestic graduate students.
» Through research partnerships and programs, take full advantage of the unique geographical location that the Department enjoys as a result of its proximity to the chemical, energy, and medical industries.

Undergraduate Program
» Recruit more and better full-time undergraduate students, focusing on both academic ability and leadership potential.
» Create an undergraduate curriculum that is responsive to changes in the Chemical Engineering field and which prepares students for a breadth of employment opportunities. The curriculum should include training that prepares students for employment, including communication skills, ethics, and financial engineering.
» Sustain high ranking of undergraduate program.

Outreach
» Conduct research that will directly benefit the State of Texas, particularly the greater-Houston area.
» Enhance the interactions with Chemical Engineering alumni, particularly those who reside in the local area.
» Provide educational opportunities for the community through specialized courses and short courses.

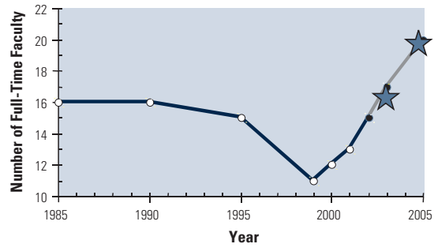


Figure 1. **Faculty Size**

Short-Term Objectives

1. **Overall Program**
a. Grow the department by at least four full-time faculty members, with at least one hire in materials and two in bioengineering.
b. Implement new Departmental name and undergraduate curriculum.
c. Improve research infrastructure.
d. In partnership with the College of Engineering, initiate new B.S. option in Biomedical Engineering.
e. Raise funds for endowed chair in Chemical and Biological Engineering.

2. **Graduate Program**
a. Increase research expenditures from approximately $150K to $200K per FTE (or a 33% increase).
b. Continually improve the quality of graduate students.
c. Increase the number of incoming domestic graduate students to at least 40% of the incoming full-time students (or a 100% increase). Establish scholarships and industrial intern program to attract students.
d. Establish a critical size in at least two core research areas that are central to the future of the Chemical Engineering profession. The research should span the fundamentals and applications in order to attract financial support from government and industry sources. The research should also involve collaboration between faculty in the Department and with other Engineering and Science faculty.
e. Establish two research centers of excellence in the Department, funded either by major government programs (e.g., NSF center) or industrial consortia members; center examples include
» Environmental reaction engineering
» Molecular bioengineering
» Thin-film electronic and polymeric materials
f. Improve the Master of Chemical Engineering program.
g. Reduce teaching loads for full-time, research-active faculty from average of 2.5–3 to 2–2.5 courses per academic year.

3. **Undergraduate Program**
a. Enhance size and quality of the undergraduate student body.
b. Continually upgrade undergraduate curriculum by (i) being more flexible for student interns, (ii) being responsive to the emerging materials and biotechnology trends in the field, and (iii) delivering excellent and up-to-date courses to our students.
c. Implement new information technology into at least three undergraduate courses, including but not limited to visualization tools, computational examples using fluid dynamics and finite-element codes, and web-based instruction.
d. Continue to adhere to Year-2000 ABET guidelines and criteria.
e. Modernize the undergraduate lab by investing in new experiments and upgrading existing experiments.

4. **Income-Producing Programs**
Establish and run at least three income-producing educational or research programs, including
» Petroleum Engineering MS in Mexico
» Chemical Engineering MS in Mexico
» Licensing of "Toluene Methylation Technology"

5. **Outreach and Communication**
a. Establish semiannual Departmental Newsletter, Annual Report, and continually upgraded Departmental web site and Graduate Brochure.
b. Increase contributions from industry for undergraduate and graduate scholarships, facilities, and equipment by 100%.
c. Establish improved relations with alumni through activities and alumni involvement in departmental initiatives. Seek to increase alumni contributions by 100%.

As of Fall 2002, the Department of Chemical Engineering will comprise 10 full professors, four associate professors, one assistant professor, two professors emeriti, three affiliated faculty, three adjunct associate professors, and 22 lecturers.

// Faculty Research Interests //

PROFESSORS

AMUNDSON, NEAL R. (PhD Mathematics, Minnesota, 1945). Cullen Professor & Professor of Mathematics. Atmospheric aerosols and particulates; reaction and diffusion; air-quality modeling.

BALAKOTAIAH, VEMURI (PhD ChE, Houston, 1982). John and Rebecca Moores Professor. Chemical reaction engineering—modeling and analysis of catalytic monoliths; numerical computation and bifurcation analysis of homogeneous and wall-catalyzed reacting flows; spatiotemporal patterns in catalytic reactions and reactors. Multiphase flow—studies on wavy films in gas-liquid two-phase flows; studies on gas-liquid two-phase flows in normal and microgravity conditions.

ECONOMIDES, MICHAEL J. (PhD Petr. E., Stanford, 1984). University Professor. Petroleum-production engineering; reservoir stimulation (fracturing and acidizing); advanced reservoir-exploitation strategies; next-generation high-intensity design.

ECONOMOU, DEMETRE J. (PhD ChE, Illinois, 1986). John and Rebecca Moores Professor; Associate Department Chairman; Director of Undergraduate Admissions. Plasma reactor modeling and simulation; plasma diagnostics; processing with energetic neutral beams; etching and deposition of thin solid films for microelectronic-device fabrication; environmental remediation; surface modification of materials.

FLUMERFELT, RAYMOND W. (PhD ChE, Northwestern, 1965). Dean of Engineering. Processing of cellular materials; environmentally benign blowing agents; nucleation in low-surface-energy materials; rheological behavior of base polymers; viscoelastic-film drainage and stability; biodegradable products for consumer applications.

HAROLD, MICHAEL P. (PhD ChE, Houston, 1985). Dow Chair Professor & Department Chairman. Multifunctional chemical reactor synthesis and analysis; high-purity hydrogen generation for fuel cells; integrated catalytic filtration devices for diesel-exhaust abatement; multiphase selective oxidation of hydrocarbons.

LUSS, DAN (PhD ChE, Minnesota, 1966). Cullen Professor. Chemical reaction engineering; dynamics of chemically reacting systems; hot-spot formation in packed-bed reactors; production of synthesis gas in membrane reactors; electrical and magnetic-field formation during high-temperature solid reactions.

MOHANTY, KISHORE K. (PhD ChE, Minnesota, 1976). Transport in microstructured media; improved oil-recovery; colloids and complex fluids; functional biomaterials.

RICHARDSON, JAMES T. (PhD Physics/Chemistry, Rice, 1955). Heterogeneous catalysis; catalytic processes; reactor engineering; solar energy; catalytic destruction of hazardous wastes; gas-to-liquid conversion processes; high-temperature superconductivity; solid-oxide fuel cells; ceramic membrane reactors; combinatorial catalysis.

ASSOCIATE PROFESSORS

KRISHNAMOORTI, RAMANAN (PhD ChE, Princeton, 1994). Director of Graduate Admissions. Structure/processing/property relations for multiphase polymers; polymer crystallinity in bulk and thin films; thermodynamics and viscoelasticity of polymer blends and copolymers; nanocomposite structure and viscoelasticity.

NIKOLAOU, MICHAEL (PhD ChE, UCLA, 1989). Process simulation, control, optimization; computer-aided process engineering.

VEKILOV, PETER G. (PhD Chemistry, Russian Academy of Sciences, 1991). Protein crystallization, intermolecular interactions, phase diagrams; thermodynamics, nucleation, phase transitions in protein solutions; physico-chemical aspects of sickle-cell anemia; structural biology; crystal growth.

WILLSON, RICHARD C. (PhD ChE, MIT, 1988). Joint Associate Professor, Biochemical & Biophysical Sciences. Biochemical separations; molecular recognition and separations; environmental biotechnology.

PROFESSORS EMERITI

HENLEY, ERNEST J. (DSc ChE, Columbia, 1953).

TILLER, FRANK M. (PhD ChE, Cincinnati, 1946). M.D. Anderson Professor; joint Professor of Civil & Environmental Engineering. Fluid/particle separation; solid processing; radiant drying; moisture transport in drying solids; solution of equations in stagewise operations.

AFFILIATED FACULTY

BRIGGS, JAMES M. (PhD Chemistry, Purdue, 1990). Assistant Professor, Biochemical & Biophysical Sciences. Computer simulation of biomolecules; HIV-1 integrase inhibitor design; re-engineering of enzyme substrate specificity.

FOX, GEORGE E. (PhD Chemistry, Syracuse, 1974). Professor of Biology & Biophysical Sciences. Artificial RNA technology; microbial monitoring; RNA design.

LEE, T. RANDALL "RANDY" (PhD Chemistry, Harvard, 1991). Associate Professor of Chemistry. Design and synthesis of new polymeric materials, drugs, drug-delivery systems; organic thin films; polymerization catalyst development.

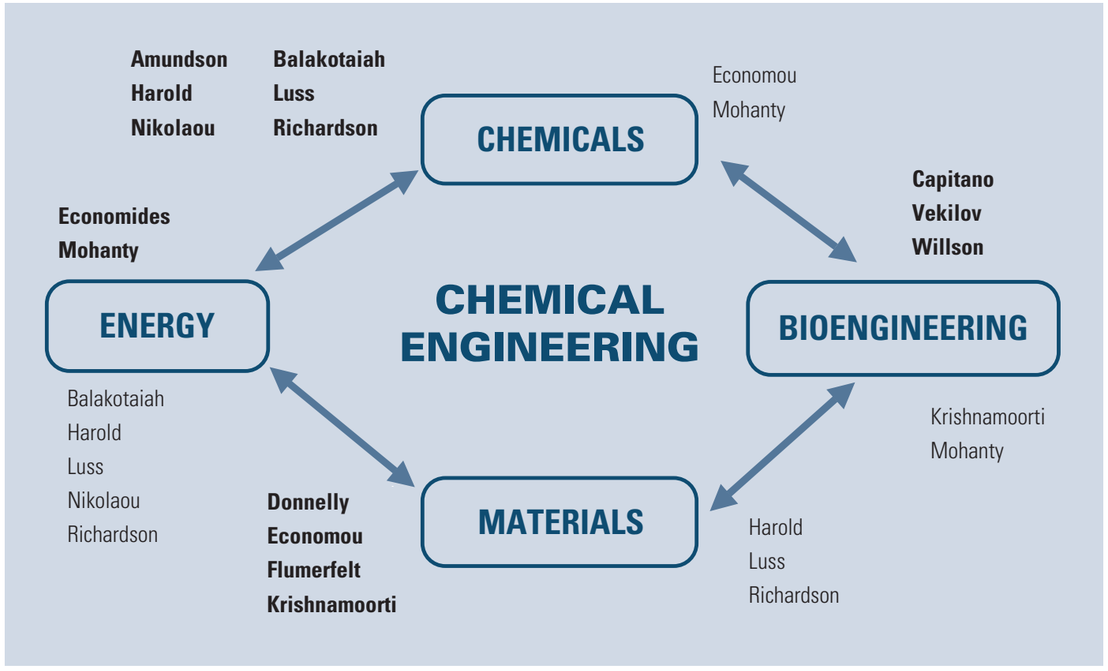


Figure 2. **Research Classification of the Faculty**

ADJUNCT PROFESSORS

ECONOMIDES, CHRISTINE A. (PhD Petr. E., Stanford, 1979). Director, Petroleum Engineering Program.

ROOKS, CHARLES W. "MICKEY" (PhD ChE, Oklahoma, 1973). Director, Undergraduate Practices Laboratory.

ADJUNCT ASSOCIATE PROFESSORS

FLEISCHER, MICKY T. (PhD ChE, Houston, 1978).

MARPLE, STANLEY JR. (PhD ChE, MIT, 1943).

OLIGNEY, RONALD E. (BSc PE summa cum laude, Alaska-Fairbanks, 1985). Director, Petroleum Institute.

LECTURERS

ChE.:
Dr. Ye-Mon Chen, Mark Dejmek, Dr. Fouad Khoury, Dr. Joseph M. Lee, Dr. Jagdish C. Maheshri, Dr. Soundar Ramchandran, Dr. Jeffrey Smith, Dr. Raymond D. Steele, Albert Swarts

Petr. E.:
Dr. Jeffrey F. App, Dr. Jon Burger, Dr. Akhil Datta-Gupta, Dr. Amiel David, Dr. Birol Dindoruk, Dr. J. Robert Gochnour, Robert O. Hubbell, Ross Kastor, John Martinez, David Murphy, Miles R. Palke, Dean C. Rietz, Dr. Grant E. Robertson

// Departmental Research Activities //

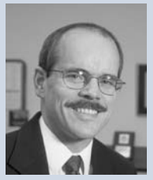
Prof. **VEMURI BALAKOTAIAH**'s research involves the mathematical modeling and analysis of the interactions between the transport processes and chemical reactions in various systems of engineering interest. The objective of the research is to gain a fundamental understanding of the complex behavior of these systems and use this understanding to practical advantage. His group's current research projects include modeling and analysis of catalytic monoliths (for pollution-reduction in automobiles, oxidation of VOCs, power generation, and removal of NOx from exhaust gases); numerical computation and bifurcation analysis of homogeneous and wall-catalyzed reacting flows; spatiotemporal patterns in catalytic reactions and reactors; studies on wavy films in gas-liquid two-phase flows; and studies on gas-liquid two-phase flows through packed beds under normal and microgravity conditions.

The research performed by Prof. **JIM BRIGGS** focuses on computational studies of protein structure and function, inhibitor design, investigations of possible inhibitor-resistance pathways, and development of methods for the above work. Targets for these studies include those important in the treatment of AIDS, cancer, tuberculosis, and other disease states.

Prof. **MICHAEL ECONOMIDES**' research involves the optimization of the overall hydrocarbon-production system from the reservoir and the wellbore to the market. He is currently conducting industry efforts for developing deep offshore technology, world energy scenario forecasts, and natural-gas development. His group's current research projects include petroleum production engineering (improving reservoir deliverability through fracturing, acidizing, and lift performance); complex well architecture in petroleum production; reservoir stimulation; advanced reservoir-exploitation strategies; and next-generation high-intensity design.

The research of Prof. **DEMETRE ECONOMOU** includes: [a.] Plasma etching and deposition: large-scale numerical simulations of plasma flow and chemistry in complex multidimensional geometries; fluid and direct-simulation Monte Carlo (DSMC) approaches; plasma diagnostics, involving laser-induced fluorescence, mass spectrometry, *in situ* real-time multichannel laser interferometry, and ion-energy and angular-distribution detectors. [b.] Plasma physics, including electron velocity distribution functions; plasma heating; and new plasma sources and chemistries for advanced integrated-circuit manufacturing. [c.] Chemical vapor deposition, specifically metallorganic chemical vapor deposition (MOCVD) of thin films. [d.] Atomic-layer processing, involving nanofabrication, and experimental realization of atomic-layer etching and molecular-dynamics simulation of the interaction of energetic beams with crystal surfaces.

The unifying theme behind the projects in the laboratory of Prof. **GEORGE FOX** is seeking an understanding of the role of RNA in the early evolution of life. Bioinformatics studies are performed on ribosomal components in bacterial genomes *et al.*, and multiple bacterial species are monitored in spacecraft environments. Artificial RNAs are used as a possible monitoring system for genetically modified bacteria.



The research interests of Prof. **MIKE HAROLD** are in the area of chemical reaction engineering. His groups carry out fundamental experiments complemented by mathematical modeling in order to understand reaction-transport interactions in chemical reactors, and to develop customized reactors for specialized applications. Areas of particular interest include reaction-separation devices and materials, environmental reaction engineering, and multiphase transport and reaction. Ongoing projects include multi-functional chemical reactor synthesis and analysis (consolidating heat-exchange and separation into single, multifunctional devices); high-purity hydrogen generation for fuel cells (converting methanol into high-purity hydrogen for on-demand supply to a protein-exchange membrane fuel cell); integrated catalytic filtration devices for diesel-exhaust abatement (reducing particulates and NOx in the net-oxidizing exhaust of lean-burn gasoline and diesel vehicles); and multiphase selective oxidation of hydrocarbons (elucidating the interactions of free-radical chemistry and transport phenomena, and developing operating schemes to optimize the contacting of hydrocarbon and oxygen).

Prof. **RAMANAN KRISHNAMOORTI** and his groups undertake research that aims to understand the structure-processing-property relations in nano- and microstructured multiphase polymer materials, building on strong collaborations with industry, national laboratories, and academia. The foremost and unique aspect of the research program has been the capability to synthesize well-defined and controlled materials (polymers and inorganic materials) and combine this with well-established measurement techniques to examine fundamental molecular and macroscopic properties that determine and characterize the final properties of multiphase polymer systems. Five specific current projects are: effect of pressure on the phase behavior of polyolefin blends; polymer crystallinity in bulk and thin films; phase transitions in block copolymers and block-copolymer-based balanced microemulsions; structure and viscoelasticity of macro- and nanocomposites; and structure and transport in biopolymers.

Prof. **RANDY LEE** and his group focus on organic and materials research chemistry. The six general areas include selectively fluorinated organic thin films; complex organic interfaces with controlled local composition, structure, and function; biologically active interfaces; nanoparticle growth and manipulation; biopolymers and conducting polymers; and polymerization catalyst development. The common thread tying all of these research areas together is synthesis, whether organic, inorganic, organometallic, or solid-state, with the goal of preparing new materials for technological applications.

Several projects of Prof. **DAN LUSS**' research groups are associated with the dynamic features of chemically reacting systems, such as reverse-flow reactors, hot-spot formation in packed-bed reactors, and the temperature-rise during polyolefin polymerization via metallocene catalysts. Dr. Luss' groups also conduct research on the use of membrane reactors to produce synthesis gas, the destruction of nitrogen oxides in reverse-flow reactors, and the formation of electrical and magnetic fields during high-temperature solid reactions. Specific projects include: dynamics of chemically reacting systems (using bifurcation theory to classify the dynamic features of various chemical reactors, with application to the destruction of NOx); hot-spot formation in packed-bed reactors; production of synthesis gas in membrane reactors (optimizing the operation of a novel membrane reactor); and electrical and magnetic-field formation during high-temperature solid reactions (during the combustion of various metals).

Prof. **KISHORE MOHANTY**'s research focuses on transport of simple and complex fluids in complex microstructured materials for applications in energy, environment, and biotechnology. This research is aimed at imaging structures, understanding the physics of transport, relating the microstructures to transport coefficients, and developing new materials for enhanced targeted transport. Current research includes: transport in microstructured media (using microscopy, microtomography, CT-scanning, and NMR to image microporous materials and the transport within); improved oil recovery (studying oil extraction by miscible flooding, and probing the interaction between flow and phase behavior); colloids and complex fluids (fluids containing surfactants and polymers are developed for stable foams, low-tension micellar solutions, and micelle-enhanced separation processes, with kinetics of hydrate dissociation being studied for potential production of natural gas from subsea hydrates); and

functional biomaterials for controlled and targeted drug-delivery (probing the relations between the molecular interaction, material nanostructure, and transport/interfacial properties).

Prof. **MIKE NIKOLAOU**'s research interests are in computer-aided systems engineering. His work emphasizes the interplay between theory and applications in a number of industries, including chemicals, energy & petroleum, microelectronics, and food processing. Prof. Nikolaou's group develops new approaches for broad classes of problems, screens candidate technologies for specific applications, and develops proofs of concept or working prototypes, frequently in collaboration with industrial sponsors. Recent topics of interest with general applicability include model predictive control, nonlinear control, system identification and adaptive control, and performance-monitoring. Areas of application include petrochemical processes, oil & gas reservoir drilling and production systems, and plasma etching of semiconductors.

Prof. **JIM RICHARDSON**'s research involves experimental heterogeneous catalysis as related to industrial processes. Topics include heterogeneous catalysis and catalytic processes, reactor engineering, and catalyst preparation, characterization, and design; solar energy, solar-receiver design, and solar-related chemical processes; gas-to-liquid conversion processes; high-temperature superconductivity and processing of ceramic superconductors; solid-oxide fuel cells; ceramic membrane reactors; and combinatorial catalysis.

Prof. **FRANK TILLER** works in the field of the processing of fluid/particle systems and separation of the particles encountered in such areas as the chemical industry, environmental protection, waste-water, pulp and paper, yeast and beer, drilling wells for petroleum, *et al.* He also works in the field of difference equations as applied to stagewise operations in distillation, gas absorption, extraction, and washing. Current projects include: theory and practice of fluid/particle separations, including filtration, thickening, centrifugation, expression, washing, flocculation, and filter aids; separation of biosolids from wastewater sludge; CATSCAN analysis of solid/liquid systems; filtration theory of supercompactible filter cakes; colloid and interfacial phenomena; developing agricultural fibers as aids in solid/liquid separation and coalescence of oily waters; ceramic and solid processing; radiant drying of fruits, vegetables, and meat; moisture transport in drying solids; and solution of ordinary and partial difference equations in numerical analysis of stagewise operations.

Prof. **PETER VEKILOV** carries out pioneering research in biomolecular engineering, with a focus on phase transitions occurring in solutions of biological macromolecules. Application areas include protein-condensation diseases, structural biology, and bio-based nanotechnology. His current research interests include: protein crystallization; physico-chemical aspects of sickle-cell anemia; crystallization tools for structural genomics; nucleation and phase transitions in protein solutions; protein intermolecular interactions and phase diagrams; criteria for the impact of reduced gravity on protein-crystal perfection; and kinetics and stability of crystal growth.

The major research interests of Prof. **RICHARD WILLSON** lie at the interface between the life sciences and engineering, and range from fairly basic investigations of fundamental phenomena to development of novel technologies. Specific areas: molecular recognition and adsorption, including separations of proteins and nucleic acids for purification and analysis, antibody and aptamer affinity and selectivity, and biophysical and structure/function characterization of driving forces and kinetics of interactions involving biological macromolecules; and environmental biotechnology, including microbial and enzymatic degradation of wastes, DNA probe technology, ribosomal RNA technology, and combinatorial methods.

// Current Research Projects & Grants //

Awards granted to the Department of Chemical Engineering

BALAKOTAIAH, VEMURI

$ 150,000 **Robert A. Welch Foundation**
"Modeling & Analysis of Spatiotemporal Patterns in Catalytic Reactions & Reactors" (2001–2004)

$ 110,000 **Texas Higher Education Coordinating Board (ATP)**
"Novel Catalysts & Reactors for Air-Pollution Control" (2000–2001)

$ 60,000 **The Dow Chemical Company**
"Bifurcation Analysis of Catalytic Reactors" (2001)

$ 44,000 **NASA—Glenn Research Center**
"Studies on Wave Occlusion in Gas-Liquid Two-Phase Flows in Normal & Microgravity Conditions" (1999–2001)

$ 12,000 **Schlumberger**
"Modeling of Wormhole Formation in Carbonate Reservoirs" (2001)

ECONOMIDES, MICHAEL J.

$324,831.98 **Halliburton Energy Services**
"Development of a Novel Methodology for Stress & Stability-related Measurements in Boreholes" (1999–2001)
** jointly with Profs. M. Nikolaou (UH) & P. Valkó (Texas A&M)*

$ 60,000.00 **Weatherford (Engineering Foundation)**
"Process Design for Complex Structures" (2000)

ECONOMOU, DEMETRE J.

$ 354,907 **National Science Foundation**
"Non-Local Transport in Inductively Coupled Plasmas" (2000–2003)

$ 35,000 **Materials Research Science & Engineering Center**
"Neutral-Beam-Assisted Deposition of Oxides" (2000–2002)

$ 30,000 **Sandia National Laboratories**
"Plasma Molding over Surface Topography" (2001–2002)

HAROLD, MICHAEL

$ 250,000 (est.) **DuPont Company**
"Temporal Analysis of Products" (TAP Reactor Facility) (2001; equipment)

$ 199,300 **Texas Higher Education Coordinating Board (ATP)**
"Integrated Catalytic Filtration Devices for Diesel-Exhaust Abatement of NOx & Particulates" (2002–2003)

$ 60,000 **ACS—Petroleum Research Fund**
"Shape-Selective Pneumatic Membrane Reactor for Enhanced Conversion & Yield in Equilibrium-Limited Sequential-Parallel Reaction Systems" (2001–2003)

$ 31,865 **BASF Corporation**
"Multiple Reactor System for UH Chemical Engineering Undergraduate Laboratory" (2001; equipment)

KRISHNAMOORTI, RAMANAN

$ 369,195 **National Science Foundation**
"Understanding the Role of Process Variables on Properties of Multiphase Polymeric Materials" (1998–2003)

$ 249,000 **ExxonMobil Chemical Company**
"High-Performance Polymeric Materials" (2001–2006)

$ 145,000 **Robert A. Welch Foundation**
"Tailoring Crystallinity in Thin Polymer Films" (2000–2003)

$ 26,000 **NIST**
"Combinatorial Screening of Nanocomposites: Mechanical & Vapor-Barrier Properties" (2000–2001)

continued

LUSS, DAN

$ 291,248 **National Science Foundation**
"Electromagnetic Fields Produced by Self-Propagating High-Temperature Synthesis (SHS)" (2001–2004)

$ 289,399 **National Science Foundation**
"Temperature Patterns on Catalytic Pellets & Radial-Flow Reactor" (1999–2002)

$ 135,000 **Robert A. Welch Foundation**
"Periodic & Chaotic Temperature Patterns on Catalytic Surfaces" (1999–2001)

$ 135,000 **U.S./Israel Binational Science Foundation**
"Control of Patterned States in Chemical Reactors" (1999–2001)
** jointly with Prof. M. Sheintuch, The Technion, Israel*

$ 70,000 **Materials Research Science & Engineering Center**
"Membrane Reactors for Synthesis-Gas Production" (2000–2001)

$ 60,000 **ACS—Petroleum Research Fund**
"Complex Dynamic Behavior of Countercurrent & Reverse-Flow Reactors" (2000–2002)

$ 47,000 **U.S. Civilian Research & Development Foundation**
"Self-Propagating High-Temperature Synthesis of Oxide & Composite Tubes in a Centrifuge" (2000–2002)

$ 11,065 **Environmental Institute of Houston**
"NOx Destruction in Reverse-Flow Reactor" (2000–2001)

MOHANTY, KISHORE K.

$ 744,250 **U.S. Department of Energy**
"Development of Shallow Viscous Oil Reserves in North Slope" (2001–2004)

$ 637, 010 **U.S. Department of Energy**
"Fluid-Rock Characterization & Interactions in NMR Well-Logging" (1999–2002)
** jointly with Prof. G. Hirasaki, Rice University*

$ 471,983 **U.S. Department of Energy**
"Impact of Capillary & Bond Numbers on Relative Permeability" (1999–2002)

$ 265,351 **U.S. Department of Energy**
"Exploitation & Optimization of Reservoir Performance in Hunton Formation, OK" (2000–2004)

$ 127,000 **Texas Higher Education Coordinating Board (ATP)**
"Computation of Transport Properties from Petrographic Images" (2000–2001)

$ 64,000 **Texas Hazardous-Waste Research Center**
"VOC Emission Control at Oil-Loading Terminals" (2000–2002)

$ 44,601 **Gulf Coast Hazardous-Substances Research Center**
"Biosurfactant Produced from Used Vegetable Oil for Removal of Metals from Wastewaters & Soils" (2000–2001)
** jointly with Prof. C. Vipulanandan, UH Civil & Environmental Engineering*

NIKOLAOU, MICHAEL

$ 325,000 **Halliburton Energy Services**
"Development of a Novel Methodology for Stress & Stability-Related Measurements in Boreholes" (1999–2001)
** jointly with Profs. M.J. Economides (UH) & P. Valkó (Texas A&M University)*

$ 143,000 **National Science Foundation**
"Design of Model Predictive Controllers with Enhanced Autonomy" (1998–2001)

$ 60,000 **Kellogg Brown & Root**
Unrestricted grant (renewable annually)

$ 58,000 **National Science Foundation & Lam Research Corporation**
"A Study on Plasma-Etching Yield Improvements through a Faculty-in-Industry Internship" (2001)

$ 46,000 **Equilon (Shell Westhollow Technology Center)**
Unrestricted grant (renewable annually)

$ 20,000 **Program B of the Faculty Development Initiative, UH Program (FDIP)**
"Development of Virtual-Reality Modules for the Visualization of Industrial Facilities by Engineering Students" (2001)

RICHARDSON, JAMES T.

$ 185,800 **Texas Higher Education Coordinating Board (ATP)**
"More-Efficient Ceramic Membrane Reactors" (2000–2002)

$ 165,000 **Gulf Coast Hazardous-Substances Research Center**
"Improved Halogen Resistance of Catalytic Oxidation through Efficient Catalyst-Testing" (2000–2001)

$ 80,000 **Materials Research Science & Engineering Center**
"SHS & Membrane Reactors" (2000–2001)

$ 76,937 **Sud-Chemie**
"Screening of Carbon Formation on Steam-Reforming Catalysts" (2000–2001)

$ 57,000 **U.S. Civilian Research & Development Foundation**
"Efficient Continuous Technology for the Production of Soft Ferrite Materials" (2001–2002)

$ 14,998 **Environmental Institute of Houston**
"An Improved Process for the Elimination of Toxic Compounds in Landfill Gas" (2000–2001)

$ 13,500 **UH Institute of Space-Systems Operations**
"Improved Sabatier Reactors for *in situ* Resource Utilization on Mars" (2000–2001)

VEKILOV, PETER G.

$ 1,134,062 **NASA**
"Effects of Convective Transport of Solute & Impurities on Defect-Causing Kinetics Instabilities" (1999–2003)

$ 791,000 **NASA**
"Physico-chemical Tools for Rational Optimization of the Growth Conditions of Biological Crystals" (2001–2004)

$ 624,548 **NASA**
"Protein & Precipitant-Specific Criteria for Impact of Reduced Gravity on Protein-Crystal Growth" (1997–2001)

$ 472,533 **National Institutes of Health/NHLBI**
"Control of Protein Nucleation & Crystallite Growth" (1998–2001)

$ 362,541 **MSFC/USRA/NASA**
"Morphological Stability of Stepped Interfaces Growing from Solution" (1998–2002)

WILLSON, RICHARD C.

$ 270,000 **National Science Foundation**
"Competitive Ion-Exchange Adsorption of Proteins" (2001–2004)

$ 150,000 **NASA—National Space Biomedical Research Institute**
"Ribosomal RNA Probe Design for Microbial Monitoring"(2000–2003)

$ 126,000 **Texas Higher Education Coordinating Board (ATP)**
"Imaging Polarimetry for Screening of Chiral Libraries" (2000–2001)

$ 120,000 **DARPA**
"Real-Time DNA Sequencing" (2001–2002)

$ 54,000 **Gulf Coast Hazardous-Substances Research Center**
"Enzymes of Cyanide Detoxification" (2000–2003)

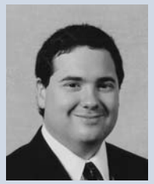
$ 37,000 **Gulf Coast Hazardous-Substances Research Center**
"Combinatorial Libraries of Heterogeneous Catalysts" (1998–2002)

// Faculty News & Activities //

DONNELLY HIRED: Prof. Vincent M. Donnelly was hired as Full Professor, effective Fall 2002. Prof. Donnelly was most recently a Distinguished Member of the Technical Staff of Agere Systems, Inc. (formerly Lucent Technologies and AT&T Bell Laboratories) in Murray Hill, NJ. He is a world-renowned expert in the field of plasma reactions and dynamics. Prof. Donnelly earned his B.A. in Chemistry from LaSalle College (Philadelphia) in 1972, and his PhD in Physical Chemistry from the University of Pittsburgh in 1977.

Appointed a Fellow of the American Vacuum Society in 1997, Prof. Donnelly chaired its Plasma Science & Technology division from 1999 until 2001. He has organized and chaired professional symposia, and served on numerous advisory committees and boards. He has won six educational, corporate, and professional awards. Early in his career, he served as a National Research Council Postdoctoral Fellow at the Naval Research Laboratory in Washington, DC. Prof. Donnelly's research interests include plasma diagnostic techniques, plasma-processing chemistry and physics, plasma etching for microelectronics and nano-technology applications, plasma-surface interactions, and applications for plasma-treated surfaces. He has more than 150 scientific publications, and nine patents. He has given approximately 100 invited lectures worldwide.

The addition of Prof. Donnelly enhances the Department's research efforts in the areas of microelectronics and plasma science and engineering, as Prof. Demetre Economou has already established a renowned program in plasmas and micro-electronics in our Department.



CAPITANO HIRED: Prof. Adam T. Capitano was hired as Assistant Professor, effective Fall 2002. Prof. Capitano earned his B.S. in Chemistry from the University of Iowa (1994) and his PhD in Chemistry from the University of Michigan (1999). Since 1999, he served as a postdoctoral associate at M.I.T. in the Liver-Based Toxin-Sensing program of Prof. Linda Griffith. He holds the distinction of having completely and successfully changed his research focus from surface science of reaction systems to biological systems.

Prof. Capitano's current research interests reflect his diverse training, including the design of tissue-based biosensors for passive defense of water systems, development of fluorescent assays for differentiated cell function, two-photon microscopic characterization of three-dimensional cultures, tissue engineering of heart valves, and adaptation of three-dimensional printing technology for tissue engineering. His addition to our Department will strengthen even further the biomolecular and biochemical programs of Profs. Richard Willson and Peter Vekilov.

KRISHNAMOORTI PROMOTED: Prof. Ramanan Krishnamoorti was promoted to Associate Professor with tenure, effective Fall 2001. Prof. Krishnamoorti has continued to develop an impressive program in polymer-nanocomposite design and synthesis since his hire in August 1994.

PROF. RICHARD WILLSON delivered 11 invited seminars during the academic year. His international talks were for the Czech Academy of Sciences (Prague), Qiagen Corporation (Hilden, Germany), Recovery of Biological Products X (Cancun, Mexico), and the 14th International Symposium on Affinity Technology & Biorecognition (San Carlos, Mexico). His presentations of research at other conferences occurred at the AIChE National Meeting (Reno), the Gordon Research Conference on Applied Environmental Microbiology, and the ACS National Meeting. He was a featured investigator at "Research in Texas Day" at the Texas State Capitol. Prof. Willson served as Chair of the UH Intellectual Property Committee, and he is the President-elect of the International Society for Molecular Recognition.

PROF. PETER VEKILOV joined the Department as Associate Professor effective Fall 2001. He taught a short course, entitled "Mechanisms of Crystallization Form Solutions," in Helsinki, Finland. During 2001, he served as Session Chair of the 13th International Conference on Crystal Growth (Kyoto, Japan) and as Discussion Leader of "Protein Crystals" at a Gordon Conference. He delivered two invited seminars during Fall 2001.

PROF. FRANK M. TILLER again received the Frank Tiller Research Award of the American Filtration & Separation Society. Prof. Tiller is an honorary professor at five Latin American universities, and he holds two honorary doctorates. He continues his research in the Department.

PROF. JAMES T. RICHARDSON remains Co-Director and Lecturer of the five-day short course "Applications of Heterogeneous Catalysis." This popular course has been presented 74 times around the world since 1973. He delivered invited seminars during technical meetings, academic visits, and industrial visits during the year. Prof. Richardson holds seven U.S. patents.

PROF. MICHAEL NIKOLAOU served as Co-Chair at two AIChE sessions and presented three papers. He wrote three internal reports for Lam Research Corporation during 2001. He served as a recruiter of undergraduate students at two Houston-area high schools, and he is the Department's AIChE Student Chapter advisor.

PROF. KISHORE MOHANTY served as Executive Editor of the SPE Journal and as volume co-editor of Current Opinion on Colloid & Interface Science. He continues as Associate Editor of the Vadose Zone Journal. He chaired both the Gordon Conference on Flow & Transport through Permeable Media and the AIChE Conference on Transport & Reaction through Heterogeneous Media. He is a member of the Louisiana RCS Review panel. Prof. Mohanty serves on the UH Radiation Safety Committee and the College of Engineering's Computer Policy Committee. Within the Department, he directs the Master of Chemical Engineering program and serves as Honors College Advisor.

PROF. DAN LUSS is the long-time editor of *Reviews in Chemical Engineering* and the *Plenum Chemical Engineering Series*. He co-directs and lectures for the popular "Applications of Heterogeneous Catalysis" short course. He is the president of the U.S. Board of Governors of the International Symposium on Chemical Reaction Engineering (ISCRE). Of his invited lectures during 2001, three were in international venues (two in Germany, one in Poland), and he presented a plenary talk at the 2001 "Dynamic Phenomena in Catalysis" symposium in Berlin. Prof. Luss serves on an estimable number of organizational review panels, search committees, and membership committees.

In 2001, **PROF. RAMANAN KRISHNAMOORTI** began a five-year term on the editorial board of the *Journal of Polymer Science Part B: Polymer Physics Edition*. He co-edited a symposium proceedings of the MRS as well as a symposium series for the ACS. He also earned the Best Fundamental Paper Award from the South Texas Section of the AIChE. Prof. Krishnamoorti served as Domestic Graduate-Admissions Advisor for the Department during the academic year.

PROF. MICHAEL HAROLD completed his first full year as Department Chairman. He successfully engineered several strategic partnerships with industry, including the donation of a TAP reactor and the process technology for Toluene Methylation from DuPont. In collaboration with Profs. V. Balakotaiah, C. Rooks, and J.T. Richardson, he is pursuing a project with the City of Houston to abate NOx emissions from diesel exhaust. Prof. Harold delivered two invited seminars and presented two papers at the AIChE National Meeting. He is the director of the Computer & Systems Technologies (CAST) Division of the AIChE, and he serves on the AIChE's Publications Committee. He also served on an *ad hoc* programming committee for the Catalysis & Reaction Engineering Division of AICHE.

PROF. DEMETRE ECONOMOU's status as a UH John and Rebecca Moores Professor was renewed for another five-year

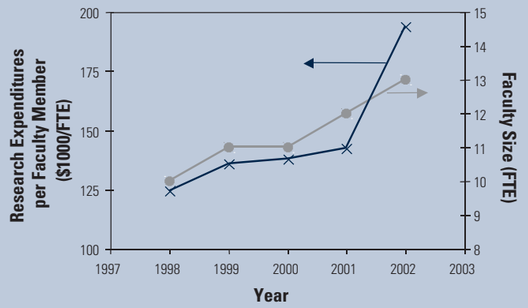


Figure 3. **Trends in Research Expenditures**

term. He presented three papers at the 54th Gaseous Electronics Conference, and one paper at the EUROCVD-13 conference (Athens, Greece). Prof. Economou is the Department's Associate Chairman, and he chairs these committees: Undergraduate Curriculum, Scholarship, Honors Program, ABET (Department); Effective Instruction, Undergraduate Curriculum, ABET (College of Engineering); and Distinguished & Named Professors (University). He serves on numerous national and international panels and committees.

During the academic year, **PROF. MICHAEL ECONOMIDES** participated in at least 20 major conferences as a keynote speaker, session chairman, or panel member. He was instrumental in organizing and carrying off a unique cooperative program involving the University of Houston, LaSalle University (Mexico), and PEMEX. In this program, students in Mexico undergo a combination of classroom and remote instruction, all from UH lecturers, and ultimately earn an MS PetrE degree from the University of Houston. This cooperation has proven extremely popular, and the program will be refined and expanded during its subsequent years.

PROF. VEMURI BALAKOTAIAH raked in two prestigious awards during the year: He was named as a John and Rebecca Moores Professor by the University of Houston, and The Dow Chemical Company presented him with its Ya. B. Zeldovich Award. Prof. Balakotaiah presented six papers at the AIChE National Meeting, and he served as the Department's Director of International Graduate Admissions during 2001. In collaboration with Profs. M. Harold, C. Rooks, and J. T. Richardson, he is pursuing a project with the City of Houston to abate NOx emissions from diesel exhaust.

PROF. NEAL R. AMUNDSON is a member of the National Academy of Engineering, the National Academy of Sciences, and the American Academy of Arts & Sciences. He was the first recipient of the Neal R. Amundson Prize, awarded at each ISCRE meeting to a recognized leader in the field of chemical reaction engineering. He also holds four honorary doctorates. The Chemical Engineering Building at the University of Minnesota is named in his honor.

In his first full year with the Department, **ADJUNCT PROF. CHARLES "MICKEY" ROOKS** won the College of Engineering's award for Outstanding Instruction, Non-Tenure-Track Faculty. Dr. Rooks, who joined the Department in the spring of 2001 after many years in industry with Monsanto and Solutia, directs the Department's Undergraduate Practices Laboratory. He is also working with Profs. V. Balakotaiah, M. Harold, and J. T. Richardson on the establishment of a diesel-emissions testing facility.

// Institute for Improved Oil Recovery (IIOR) //

in the University of Houston Department of Chemical Engineering

The Institute for Improved Oil Recovery (IIOR) conducts its university research via a research consortium that is funded by major oil and gas producers, service companies, the U.S. Department of Energy, and the state of Texas. After research has been conducted through cooperative university and industrial projects, results are presented in conferences and workshops around the United States.

Research areas include:

- Advanced computing technology applied to reservoir engineering
- Three-dimensional imaging of flow through porous media
- Gas-flooding methods (CO_2, hydrocarbon, N_2)
- Displacement mechanisms
- Foams
- Fractured reservoirs
- Formation evaluation
- Environmental engineering/containment technologies
- Particle transport, surface chemistry, wettability.

THE SIGNIFICANCE OF IMPROVED OIL-RECOVERY TECHNOLOGY:

The U.S. Department of Energy and other entities have estimated that less than one-third of the original oil in place can be produced with existing technologies. Hence, recovery of the remaining two-thirds constitutes the target for development of improved technologies. Approximately 341 billion barrels of mobile and immobile oil will remain bypassed or trapped in known U.S. reservoirs at the conclusion of conventional production. Of this remaining oil, it is estimated that an additional 76 billion barrels are recoverable by currently identified technologies with the application of well-designed R&D and technology-transfer strategies. This would sustain current levels of U.S. production for several decades, which is necessary for an orderly transition to alternative transportation fuels. Improved technology allows producers to work more efficiently and to extract more oil than otherwise.

The natural-gas supply from conventional resources is estimated to be approximately 800 trillion cubic feet (Tcf), of which 160 Tcf are proven reserves and 640 Tcf are inferred or undiscovered reserves. Half the conventional undiscovered gas is considered economical to produce, with improved recovery methods being necessary to convert this gas to reserves. The remaining 50% is also expected to require improved drilling, completion, and gathering technology. A reduction in imported oil could be one near-term payoff when new reserves are developed via improved exploration and extraction techniques. Fuel-switching in stationary markets could enable the replacement of two million barrels/day of oil (25% of imports) with 4 Tcf/year of gas. Technology can make a difference.

Contact:
Prof. Kishore K. Mohanty, Director
University of Houston
Department of Chemical Engineering
S222 Engineering Bldg. 1
Houston, TX 77204-4004
713-743-4331
713-743-4323 fax

The mission of the Institute for Improved Oil Recovery (IIOR) is to improve recovery of crude oil and natural gas under present-day economics, apply improved oil-recovery technology to the in situ *clean-up of hazardous wastes, and transfer technology to industry and national laboratories. The scope of the program encompasses R&D and field demonstration, testing, and evaluation.*

DEPARTMENTAL FUNDING, SUPPORT, RANKINGS, & TRENDS

DEPARTMENTAL SUPPORT & GRADUATE FELLOWSHIPS

As of June 2002, the UH ChE research program comprised 54 full-time graduate students, 8 postdoctoral fellows, 46 Petroleum Engineering students, and 21 part-time Master of Chemical Engineering students (the industrially employed professionals who are attracted to our non-thesis terminal-degree option). The program is supported by the following sources:

State Budget		
Departmental	$	1,775,591.07
Research	$	192,471.07
HEAF	$	113,076.27
----------	**$**	**2,081,138.41**
Federal		
NSF	$	601,889.90
NASA	$	162,376.97
Sandia	$	21,366.38
US-Foreign Support	$	26,697.93
DOE/EPA	$	239,886.44
IDC	$	32,218.97
----------	**$**	**1,084,436.59**
University Funds		
Endowments & Fees	$	392,690.53
----------	**$**	**392,690.53**
Private Grants		
Welch Foundation	$	192,754.17
ACS-PRF	$	25,620.52
----------	**$**	**218,374.69**
Industrial		
ExxonMobil, Shell, Dow, BP/Amoco	$	200,387.82
Local Industrial Funds	$	232,089.18
----------	**$**	**432,477.00**
GRAND TOTAL	**$**	**4,209,117.22**

OUTSTANDING ALUMNI

These graduates of the UH Chemical Engineering program have received the UH Engineering Alumni Association's "Distinguished Alumnus" Award:

Robert Baldwin	BS, 1949
William Brookshire	BS, 1957
Robert M. Zoch, Jr.	BS, 1968
J.C.M. "Jimmy" Lee	PhD, 1970
Ravi Singhania	PhD

DONOR ORGANIZATIONS

The Department of Chemical Engineering is most grateful for the support contributed by these industrial, educational, and nonprofit organizations:

American Institute of Chemical Engineers
BASF Corporation
BP/Amoco
CAChE Corp.
Chevron U.S.A. Inc.
Council for Chemical Research
The Dow Chemical Company Foundation
The Dow Chemical Company
E.I. DuPont de Nemours & Company
ExxonMobil
Fluor Corp.
Halliburton Foundation, Inc.
The Lubrizol Foundation
Marathon Oil Company
Pennzoil Products Company
Rohm and Haas Company
Shell Oil Company Foundation

INDUSTRIAL ADVISORY BOARD

The Chemical Engineering Department has an Industrial Advisory Board (IAB). The IAB provides the Chemical Engineering chairman and faculty an industrial perspective on important strategic and operational issues. With input and advice, the IAB addresses such salient topics as faculty hiring, student recruitment, curriculum content, and graduate research programs. The IAB members also provide a network through which fundraising efforts, student recruiting and internships, and engagement of alumni are enhanced.

Members of the IAB are:

Air Products & Chemicals, Inc. (Houston, TX)
Steve Hensler, Area Manager

Andersen (Houston, TX)
M. Bernadette Cullinane, Senior Manager

Aspen Technology, Inc. (Houston, TX)
Rob Hawkins, Director, Product Marketing

ATOFINA Petrochemicals, Inc. (Deer Park, TX)
Dr. Michel Daumerie, Vice-President of Research & Technology
Dr. José Sosa, Research Scientist

BASF Corporation (Freeport, TX)
James P. Saccomanno, Operations Director

Bayer Corporation (Baytown, TX)
Dr. Thomas Daszkowski, Manager, Process Technology Group

Bechtel Corp. (Houston, TX)
Lance Murray, Principal VP, Manager of Refining Center of Excellence

Chemstations, Inc. (Houston, TX)
Nathan D. Massey, President

Conoco Inc. (Houston, TX)
Alok Jain, Manager, Project Engineering & Management, EPT

Cutler Johnston Corporation (Houston, TX)
Dr. Charles R. Cutler, President

The Dow Chemical Company (Freeport, TX)
Craig W. Snook, Director of Process Analytical, Texas Operations

DuPont Lycra® (Wilmington, DE)
Dr. William D. Hill, Global Technology Manager—Terathane®

M.A. Ervin & Associates (Austin, TX)
Dr. Michael A. Ervin, President

Ethyl Corporation (Pasadena, TX)
Kang Buoy, Plant Manager

ExxonMobil Chemical (Baytown, TX)
Joseph E. Carey, Manager, Polypropylene Technology

Fluor Corp. (Sugar Land, TX)
Michael J. Piwetz, Vice-President, Process Engineering

Haldor Topsoe, Inc. (Houston, TX)
Alex E.M. Barloewen, Executive VP & General Manager

Halliburton Energy Services (Duncan, OK)
Dr. Ron Morgan, Technical Excellence Leader, Research

Kellogg Brown & Root (Houston, TX)
Tim Challand, Vice-President, Global Engineering

The Lubrizol Corporation (Deer Park, TX)
Harold Smith, Technology Manager for the Texas Plants

Marathon Ashland (Texas City, TX)
Michael S. Armbrester, Division Manager

OxyVinyls, L.P.—Houston Operations (Deer Park, TX)
Kenneth J. Carlson, Technical Manager, Chlor-Alkali

Pennzoil-Quaker State Co. (The Woodlands, TX)
Dr. Ahmed Alim, Senior VP of Research & Development and Chief Technology Officer

Phillips 66 Co. (Sweeny, TX)
Robert J. Mitchell, Refining Process-Engineering Manager

Rohm and Haas Texas Incorporated (Deer Park, TX)
Robert W. Brinly, President & Plant Manager

SABIC Americas, Inc. (Sugar Land, TX)
Dr. Syed Bughdadi, Division Manager

Schlumberger—Oilfield Chemicals (Sugar Land, TX)
Dr. Keith Dismuke, Department Head

Shell Chemical Company (Houston, TX)
Dr. Carlos E. Garcia, Technology Manager—PDO/Corterra Polymers

// Graduate Ranking: National Research Council //

Besides featuring the top-ranked doctoral program in the University of Houston, the Chemical Engineering Department ranked in the top 20 nationally out of 93 ChE doctoral programs rated by the National Research Council (1995):

RELATIVE RANKINGS FOR RESEARCH-DOCTORATE PROGRAMS IN CHEMICAL ENGINEERING

OVERALL RANKING	INSTITUTION	NRC SCORE
1	University of Minnesota	4.86
2	Massachusetts Institute of Technology	4.73
3	University of California, Berkeley	4.63
4	University of Wisconsin (Madison)	4.62
5	University of Illinois (Urbana-Champaign)	4.42
6	California Institute of Technology	4.41
7	Stanford University	4.35
8	University of Delaware	4.34
9	Princeton University	4.14
10	University of Texas at Austin	4.08
11	University of Pennsylvania	3.97
12	Carnegie Mellon University	3.87
13	Cornell University	3.86
14	University of California, Santa Barbara	3.82
15	Northwestern University	3.75
16	Purdue University	3.67
17	**UNIVERSITY OF HOUSTON**	**3.66**
18	University of Michigan	3.52
19	City University of New York	3.46
20	University of Washington	3.44
T21	University of Massachusetts at Amherst	3.35
T21	Rice University	3.35
23	Pennsylvania State University	3.34
24	University of Notre Dame	3.30
25	North Carolina State University	3.20
26	University of Colorado	3.18
27	Lehigh University	3.13
28	University of California, Davis	3.11
29	State University of New York at Buffalo	3.08
T30	University of Virginia	3.01
T30	Georgia Institute of Technology	3.01

Source: NRC report, "Research-Doctorate Programs in the United States: Continuity and Change" (1995).
The NRC produces these reports once every 10 years.

// Enrollment Trends & Degrees Conferred //

Enrollment figures are as of the start of the Fall semesters in the years indicated.
Degree figures are totals of those conferred at the ends of the Spring semesters in the years indicated.

UNDERGRADUATE ENROLLMENT & DEGREES CONFERRED:

YEAR:	1994	1995	1996	1997	1998	1999	2000	2001
Fall Enrollment:	480	445	460	383	373	317	295	291
BS Degrees:	38	46	43	40	36	40	29	31

GRADUATE ENROLLMENT & DEGREES CONFERRED:

YEAR:	1994	1995	1996	1997	1998	1999	2000	2001
Fall Enrollment:	107	135	113	98	95	103	94	99
MS Degrees in ChemE:	11	7	12	9	16	14	9	11
MS Degrees PetroleumE:	10	13	16	7	8	6	7	8
PhD Degrees:	17	10	16	7	12	7	6	10
MChE Degrees:	5	13	6	6	7	6	8	4

Chemical Engineering Weighted Student Credit Hours
(Factors: LDGL = 0.87, UDUG = 1.0, Masters = 2.37, PhD = 6.18)

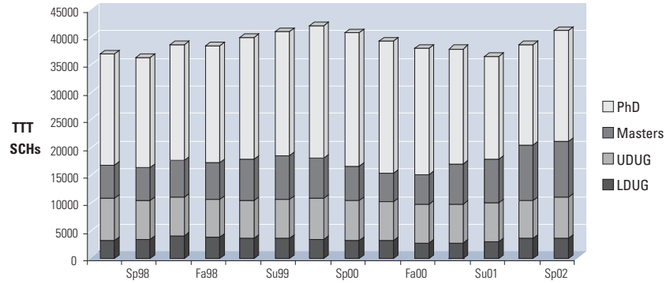


Figure 4. **Weighted Student Credit Hours**
A trendline of the weighted student credit hours shows a modest growth over the past year.

YEAR:	1985	1990	1995	2000	2001	2002
Faculty:	16	16	15	12	13	15
Enrollment						
» Undergraduate:	229	313	445	295	291	330
» Graduate:	66 *	126	135	112	99	102
Student/Faculty						
» Undergraduate:	14	20	28	25	22	22
» Graduate:	4.1 *	7.9	9.0	9.3	7.6	7.9

**Excludes MChE students*

Figure 5. **Faculty and Student-Body Trends**

// Students Receiving Degrees //

** NOTE: Some students have filed Privacy Requests and are thus not listed here.*

2001–2002 BS CHE GRADUATES WITH HONORS AND/OR MEMBERSHIP IN THE HONORS COLLEGE

Maricela Amador *(Honors)*
Thanh D. Bui *(cum laude)*
Charles H. Campbell *(cum laude, Honors)*
Brian S. Daly *(Honors)*
Rajeev J. Das *(cum laude)*
Angel D. Hinojosa *(cum laude)*
Enrique A. Lares *(magna cum laude)*
Paula A. Meneses *(magna cum laude)*
Yasser Qutub *(summa cum laude)*
Avelino Reyes-Alfonso, Jr. *(cum laude, Honors)*
May B. Shek *(summa cum laude, Honors)*
Sol E. Soto *(magna cum laude)*
Joey D. Stowers *(magna cum laude)*
Binh V. Vu *(cum laude)*
Thomas C. Wilson *(cum laude)*

RECIPENTS *(since Summer 2001)*:

Master of Chemical Engineering
Ainara Agreda
Michael Calderon
Kathleen Dixon
Hung M. Nguyen

M.S. in Chemical Engineering
Barbara F. Casanueva
Karen S. Coym
Emmanuelle M. Croze
Jinxia Deng
Urs Fitzi
William B. Focke
Maria Gennata
Keesu Jeon
David L. Jewell
Shruti K. Modi

M.S. in Petroleum Engineering
Sakiru A. Ayoade
Richard P. Dixon
Cesar Portilla
Agustin Presas, Jr.
Anne Taillefert
Ivan E. Terez
Yvonne C. Trujillo
Lewis M. Warlick

2001–2002 RECIPIENTS, PHD IN CHEMICAL ENGINEERING

Jeffrey F. App, Relative Permeability Estimation through Production Data *(K. Mohanty, advisor)*

Stefanie A. Brown, The Kinetics of Exothermic Reactions on Ceramic Foam Catalysts *(J.T. Richardson, advisor)*

Eric K. Dao, Modeling & Experimental Studies on Wave Evolution & Occlusion for Gas-Liquid Flows through Pipes *(V. Balakotaiah, advisor)*

Rohit Garg, Dynamic of Countercurrent Flow & Reverse-flow Reactors *(D. Luss, advisor)*

Doosik Kim, Plasma Molding over Nonplanar Surfaces *(D. Economou, advisor)*

Ying Peng, Transport Properties of Ceramic Foam for Catalyst-Support Application *(J.T. Richardson, advisor)*

Sathish Sankaran, Development of Process Models from Operation Data: Studies in Hydraulic Fracturing & Predictive Control *(M. Nikolaou, advisor)*

Mohit Singh, Dynamic Pore-Level Modeling of Two-phase Flow through Porous Media *(K. Mohanty, advisor)*

Koray Yurekli, Structure & Dynamics of Filled Polymeric Systems *(R. Krishnamoorti, advisor)*

Haiyang Zhang, Spatial Uniformity Control of Plasma Etching in Inductively Coupled Plasma Reactors *(D. Economou & M. Nikolaou, advisors)*

FACULTY PUBLICATIONS

Following are authored works accepted for or pending publication since January 2001. Reprints may be requested from the professors through the Departmental mailing address, by phone, or by e-mail.

BALAKOTAIAH, VEMURI

Balakotaiah, V., N. Gupta and D.H. West, "Transport-Limited Pattern Formation in Catalytic Monoliths," *Chem. Eng. Sci.* **57**, 435 (2002).

Balakotaiah, V. and D.H. West, "Shape Normalization and Analysis of the Mass-Transfer-Limited Regime in Catalytic Monoliths," *Chem. Eng. Sci.* **57**, 1269 (2002).

Chakraborty, S. and V. Balakotaiah, "Low-Dimensional Models for Describing Mixing Effects in Laminar-Flow Tubular Reactors," *Chem. Eng. Sci.* **57**, 2545 (2002).

Chakraborty, S. and V. Balakotaiah, "Two-Mode Models for Describing Mixing Effects in Homogeneous Reactors," *AIChE J.* (in press, 2002).

Chakraborty, S. and V. Balakotaiah, "A Novel Approach for Describing Micromixing Effects in Homogeneous Reactors," *Chem. Eng. Sci.*, ISCRE-17 issue (in press, 2002)—also *Chem. Eng. Educ.* **36**, 250 (2002).

Motil, B.J., V. Balakotaiah and Y. Kamotani, "Gas-Liquid Two-Phase Flows through Packed Beds in Microgravity," *AIChE J.* (in press, 2002).

Balakotaiah, V. and H.-C. Chang, "Hyperbolic Homogenized Models for Thermal and Solutal Dispersion," *SIAM J. Appl. Math* (in press, 2002).

Gupta, N., V. Balakotaiah and D.H. West, "Bifurcation Analysis of a Two-Dimensional Monolith Reactor Model," *Chem. Eng. Sci.* **56**, 1435 (2001).

Gupta, N. and V. Balakotaiah, "Heat and Mass-Transfer Coefficients in Catalytic Monoliths," *Chem. Eng. Sci.* **56**, 4771 (2001).

Conference proceedings:
Panga, M., V. Balakotaiah and M. Ziauddin, "Modeling, Simulation and Comparison of Models for Wormhole Formation during Matrix Stimulation of Carbonates," *SPE 77369,* presented at the 2002 SPE Annual Technical Conference & Exhibition, New Orleans (2002).

Motil, B.J., V. Balakotaiah and Y. Kamotani, "Effects of Gravity on Cocurrent Two-Phase Gas-Liquid Flow through Packed Beds," *AIAA Proceedings* (2001).

Books & book chapters:
Mohanty, K.K., V. Balakotaiah and R. Erskine, "Physics of Hydrocarbons in Porous Media," accepted for publication in **Energy Integration** (M.J. Economides, ed.), to appear (2002).

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Zhang, Z., R.C. Willson and G.E. Fox, "Identification of Characteristic Oligonucleotides in the 16S Ribosomal RNA Sequence Dataset," *Bioinformatics* **18**, 244-250 (2002).

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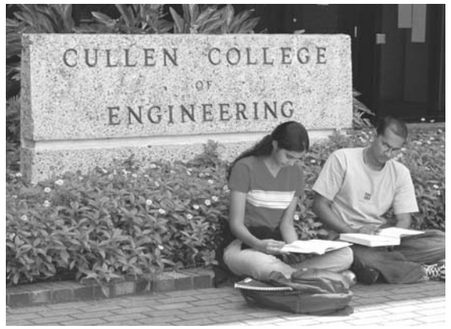
THE UNDERGRADUATE PROGRAM

Joey Stowers and Maricela Amador, recent graduates

The **UNDERGRADUATE CHEMICAL ENGINEERING PROGRAM** of the **UNIVERSITY OF HOUSTON** is consistently rated among the **top programs** in the country (10th in the recent Gourman Report).

// ChE UNDERGRADUATE ADMISSION //



Students seeking admission as freshmen to the Cullen College of Engineering should refer to: **www.uh.edu/enroll/admis/freshman_req.html** for the current and complete requirements.

Students aspiring toward undergraduate Chemical Engineering study at the University of Houston may request applications from:

Undergraduate Admissions Office
University of Houston
122 E. Cullen Bldg.
Houston, TX 77204-2023, U.S.A.

ENROLLMENT TRENDS:

YEAR*	ENROLLMENT
1975	237
1980	356
1981	423
1982	470
1983	596
1984	322
1985	229
1986	167
1987	205
1988	200
1989	260
1990	313
1991	385
1992	479
1993	545
1994	480
1995	445
1996	460
1997	383
1998	373
1999	317
2000	295
2001	291

** at the beginning of the academic period.*

Figures since 1991 include students registering as Postbaccalaureates. Enrollment figures have followed national trends.

The success of our program is due to the soundness of our undergraduate curriculum, the commitment of our faculty (all of whom teach undergraduate courses), and the support of local petroleum and petrochemical industries. We look forward to continued growth in the future and to the changes in chemical engineering education demanded by the 21st century.

Transfer applicants who have earned fewer than 15 semester hours of college credit must meet the engineering requirements for high-school graduates. Applicants who have earned between 15 and 29 semester hours of college credit must meet all of these requirements:

1. A grade-point average (GPA) of 2.50 or higher for all college-level work attempted.
2. A GPA of 2.50 or higher for all college-level mathematics courses attempted.
3. A GPA of 2.50 or higher for all college-level chemistry and physics courses attempted.
4. A GPA of 2.50 or higher for all college-level English courses attempted; international students must have a TOEFL score of 550.
5. A GPA of 2.50 or higher for all college-level engineering courses attempted.
6. Must have attempted at least one college-level mathematics course and at least one college-level physics or chemistry course.

Transfer applicants who have earned 30 or more semester hours of college credit must meet all of these requirements:

1. A GPA of 2.25 or higher for all college-level work attempted.
2. A GPA of 2.25 or higher for all college-level mathematics courses attempted.
3. A GPA of 2.25 or higher for all college-level chemistry and physics courses attempted.
4. A GPA of 2.25 or higher for all college-level English courses attempted; international students must have a TOEFL score of 550.
5. A GPA of 2.25 or higher for all college-level engineering courses attempted.
6. Must have attempted at least one college-level mathematics course and at least one college-level physics or chemistry course.

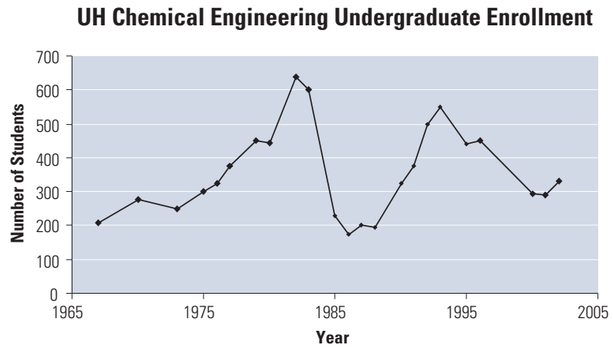


Figure 6. **Undergraduate Enrollment Trends**

Applicants with special questions about the undergraduate Chemical Engineering program may contact:

Mrs. Sharon Gates
Undergraduate-Admissions Analyst
University of Houston
Chemical Engineering
S222 Engineering Bldg. 1
Houston, TX 77204-4004, U.S.A.
Phone: 713-743-4325
E-mail: SMGates@uh.edu

// Undergraduate Courses: Chemical Engineering (CHEE) //

1131: Challenge of Chemical Engineering Cr. 1 (1-0). *Prerequisites:* Science or Engineering major. The Chemical Engineering professions. Strongholds and frontiers of Chemical Engineering. Career opportunities for chemical engineers. Communication skills; engineering ethics.

1331: Computing for Engineers (also CIVE 1331, INDE 1331) Cr. 3 (2-2). *Prerequisite:* MATH 1431. Credit cannot be received for more than one of CHEE 1331, CIVE 1331, or INDE 1331. Introduction to the computing environment, matrix arithmetic, programming essentials, spreadsheets, symbolic algebra tools, solution of typical engineering problems using computer tools.

2331: Chemical Processes Cr. 3 (3-0). *Prerequisites:* CHEE or CIVE 1331, MATH 1432, PHYS 1321, and credit for or concurrent enrollment in MATH 2433 and CHEM 1332. Introduction to chemical engineering, calculations, unit equations, process stoichiometry, material and energy balances, states of matter, case studies.

2332: Chemical Engineering Thermodynamics I Cr. 3 (3-0). *Prerequisites:* CHEM 1332, MATH 2433, PHYS 1321, CHEE 2331. Fundamental concepts of thermodynamic systems, heat and work, properties of pure substances, first and second laws.

3300: Materials Science & Engineering I Cr. 3 (3-0). *Prerequisite:* CHEE 2331, CHEM 1332, PHYS 1321, and credit for or concurrent enrollment in MATH 3321. Properties of materials, with emphasis on metals, ceramics, polymers, and electronic materials.

3333: Chemical Engineering Thermodynamics II Cr. 3 (3-0). *Prerequisite:* CHEE 2332. Multicomponent systems, phase equilibria, and prediction of thermodynamic properties.

3334: Statistical & Numerical Techniques for Chemical Engineers Cr. 3 (3-0). *Prerequisites:* CHEE or CIVE 1331, CHEE 2332, MATH 3321 or equivalent, and credit for or concurrent enrollment in ENGI or CHEE 3363. Statistics for chemical engineers, curve-fitting, numerical methods in linear algebra, nonlinear algebraic equations, ordinary and partial differential equations, optimization. Special emphasis on problems appearing in chemical engineering applications.

3363: Fluid Mechanics for Chemical Engineers (formerly ENGI 3363) Cr. 3 (3-0). *Prerequisites:* CHEE 2332, MATH 3321 or equivalent, MECE 3400, PHYS 1321, and credit for or concurrent enrollment in CHEE 3334. Foundations of fluid mechanics, fluid statics, kinematics, laminar and turbulent flow; macroscopic balances; dimensional analysis and flow correlations.

3367: Process-Modeling & Control Cr. 3 (3-0). *Prerequisites:* CHEE 3334, CHEE or ENGI 3363, MATH 3321, and PHYS 1322. Modeling techniques of chemical engineering problems, with emphasis on process control.

3369: Chemical Engineering Transport Processes Cr. 3 (3-0). *Prerequisite:* CHEE or ENGI 3363. Mass transfer in single- and multiphase systems and combined heat- and mass-transfer. Selected topics in heat and mass transfer, and in heat and momentum transfer.

3399-4399: Senior Honors Thesis Cr. 3 per semester. *Prerequisites:* senior standing; 3.00 cumulative grade-point average in chemical engineering and overall.

3462: Unit Operations Cr. 4 (3-1 [1-2]). *Prerequisites:* CHEE 3333, CHEE or ENGI 3363, and credit for or concurrent enrollment in CHEE 3369. Unit operations, with emphasis on distillation, absorption, extraction, and fluid-solid systems.

3466: Biological & Physical Chemistry Cr. 4 (4-0). *Prerequisite:* CHEE 3333, CHEM 3332. Introduction to biochemistry, and physical-chemical topics including chemical kinetics and adsorption.

4198:4298:4398:4498: Special Problems Cr. 1-4 per semester, or more by concurrent enrollment. *Prerequisite:* approval of the Chairman.

4300: Materials Science & Engineering II Cr. 3 (3-0). *Prerequisites:* CHEE 3300, 3333, 3363. Advanced topics in the selection and design of materials. Topics covered will include phase diagrams, corrosion and degradation, property selection and control, and four topical case studies.

4321:4322: Chemical Engineering Design Cr. 3 per semester (3-0). *Prerequisites:* CHEE 3333, 3462, 3369, and credit for or concurrent enrollment in CHEE 4367. Computer-aided design of chemical processes, with emphasis on process economics, profitability analysis, and optimal operating conditions.

4361: Chemical Engineering Practices Cr. 3 (1 1/2-5). *Prerequisites:* CHEE 3462, 3467, 3369, and credit for or concurrent enrollment in CHEE 4367. Design and execution of experiments, with emphasis on heat and mass transport, unit operations, process control, and reactors. Written reports.

4366: Biochemical Engineering Cr. 3 (3-0). *Prerequisites:* CHEE 3466 and credit for or concurrent enrollment in CHEE 4367. Analysis and design fundamentals for biochemical process, reactor design, transport phenomena; applications of enzymes and microbial populations.

4367: Chemical Reaction Engineering Cr. 3 (3-0). *Prerequisites:* CHEE 3366, 3369, and 3462. Chemical-reaction kinetics, mechanisms, and reactor design in static and flow systems; introduction to heterogeneous catalytic reactions in flow systems.

5360: Biochemical Engineering Fundamentals Cr. 3 (3-0). *Prerequisite:* credit for or concurrent enrollment in CHEE 4367. Analysis and design fundamentals for biochemical process, reactor design, transport phenomena; applications of enzymes and microbial populations.

5367: Advanced Process Control Cr. 3 (3-0). *Prerequisite:* CHEE 3367 or consent of instructor. Application of the use of high-speed computers in the control of chemical processes, reactors, and units.

5371: Pollution-Control Engineering Cr. 3 (3-0). *Prerequisites:* credit for or concurrent enrollment in CHEE 4321 and CHEE 4367. Pollution problems and remedies with the Earth as an environmentally closed system. Limitations of absorption and self-cleaning for terrasphere, hydrosphere and atmosphere, and their interrelationship.

5373: Environmental Remediation Cr. 3 (3-0). *Prerequisites:* ENGI 3363, CHEE 3462, and credit for or concurrent enrollment in CHEE 4367. In situ and ex situ methods of remediation or restoration of contaminated environmental sites. Emphasis is on hydrocarbon contaminants in soil, surface water, and groundwater.

5374: Reaction Kinetics for Industrial Processes Cr. 3 (3-0). *Prerequisite:* Credit for or concurrent enrollment in CHEE 4367. Methods for predicting product distribution in practical chemical reactors. Determination of thermochemical and kinetic constants from statistical mechanics and transition-state theory. Applications from vapor-phase processes to catalysis.

5375: Chemical Processing in Microelectronics Cr. 3 (3-0). *Prerequisite:* CHEE 4367 or consent of instructor. Chemical engineering principles applied to microelectronic-device fabrication and processing.

5376: Solid/Liquid Separation—Environmental Processes Cr. 3 (3-0). *Prerequisite:* CHEE or ENGI 3363. introduction to solid/fluid separation and processing. Particle characteristics, porous media; interfacial phenomena; flow through compactible and granular beds; sedimentation, clarification, filtration, centrifugation, expression, washing.

5377: Introduction to Polymer Science Cr. 3 (3-0). *Prerequisite:* CHEE 3363, and either 3366 or 3466 or consent of instructor. Synthesis, characterization, physical properties and processing of polymeric materials. Methods to measure and characterize the correlations among structure-processing properties of polymeric materials.

5379: Safety & Reliability Cr. 3 (3.0). *Prerequisites:* CHEE 3363, 3369, 3367. An overview of risk, safeguards, and hazards associated with chemical process engineering. Layers of protection, hazard identification, source-term models, toxic release and dispersion models, fires and explosions, probabilistic analysis, fault-tree analysis, designs to prevent accidents, safety-instrumented systems, and safety-related standards and regulations.

5380: Biochemical Separations Cr. 3 (3-0). *Prerequisite:* senior standing in Chemical Engineering, or consent of instructor. Producing cloned proteins in useful amounts; use of recombinant DNA methodologies to produce proteins; characterization methods.

5383: Advanced Unit Operations Cr. 3 (3-0). *Prerequisite:* senior standing in Chemical Engineering, or consent of instructor. Property prediction of multicomponent fluids. Advanced principles of heat-exchanger design, multicomponent fractionation, absorption, stripping, and extraction.

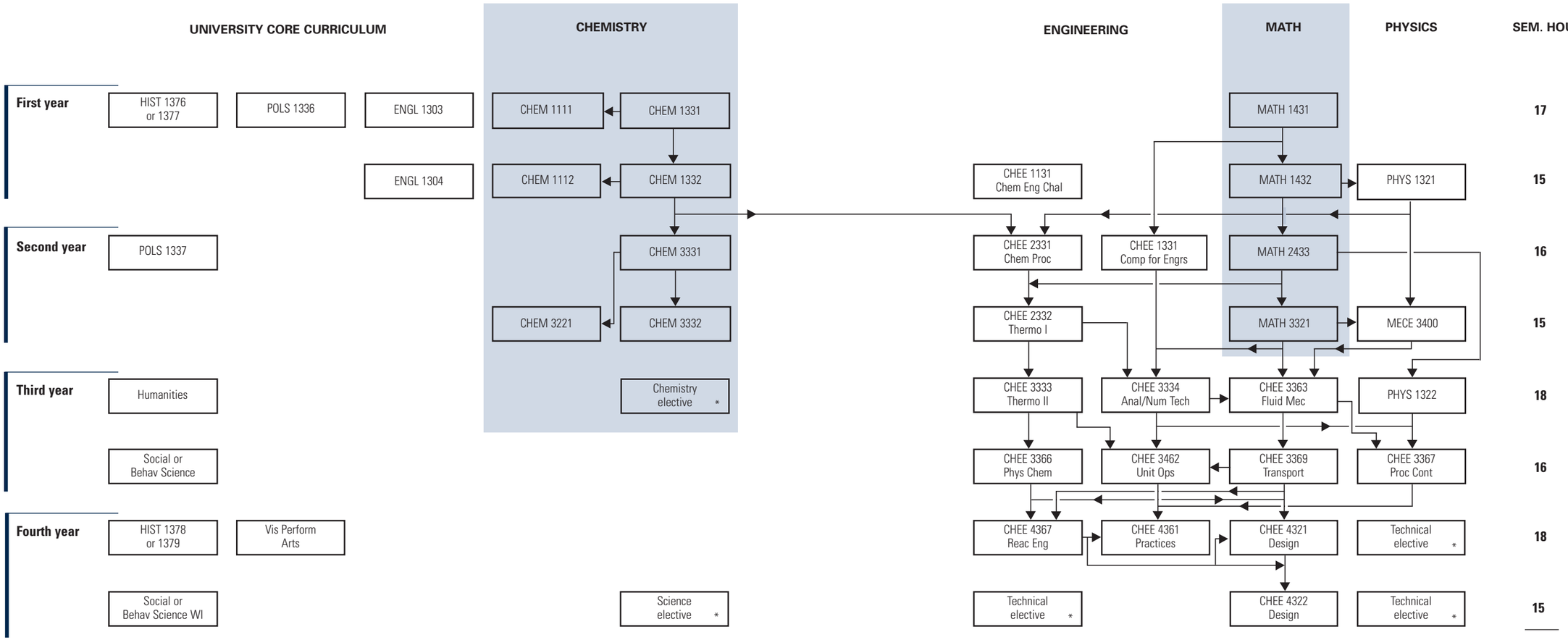
5384: Petrochemical Processes Cr. 3 (3-0). *Prerequisite:* consent of instructor. Description of the petrochemical industry in terms of products, feedstocks, companies, and future trends. Markets, technology, and economics are provided for each of the major building blocks and derivatives to the end products.

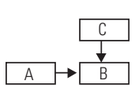
5386: Air-Pollution Problems & Control Cr. 3 (3-0). *Prerequisite:* consent of instructor. Air-pollutant identification and control technology; estimation of pollutant transport, dispersion, and conversion; computer application for design of control units.

5387: Plasma Processing: Principles & Applications Cr. 3 (3-0). *Prerequisites:* senior standing in Engineering or Natural Sciences, or consent of instructor. Principles of low-pressure glow-discharge plasmas; plasma generation and maintenance, plasma chemistry, plasma diagnostics. Applications with emphasis on semiconductor manufacturing.

5388: Catalytic Processes Cr. 3 (3-0). *Prerequisites:* credit for or concurrent enrollment in CHEE 4321 and 4367. Process-oriented survey of catalytic technology; catalyst selection and design; catalytic processes, engineering and economics in the petroleum, chemical, and pollution-control industries.

// Undergraduate Chemical Engineering Curriculum //





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2. Arrow to side of box (credit or registration in A at the same time as B)

** From Approved Courses*

// Undergraduate Degree Plan //

Effective Fall 2002.

FIRST YEAR

FALL SEMESTER

Course #	Course	Hrs.
CHEE 1131	Chem. Engng. Challenges	1
CHEM 1111	Fund. of Chemistry Lab	1
CHEM 1331	Fundam. of Chemistry	3
ENGL 1303	English Composition I	3
HIST 1376/7	U.S. History to 1877	3
MATH 1431	Calculus I	4
POLS 1336	U.S. & Texas Politics	3
		18

SPRING SEMESTER

Course #	Course	Hrs.
CHEM 1112	Fund. of Chemistry Lab	1
CHEM 1332	Fundam. of Chemistry	3
ENGL 1304	English Composition II	3
MATH 1432	Calculus II	4
PHYS 1321	Engineering Physics I	3
		14

SECOND YEAR

FALL SEMESTER

Course #	Course	Hrs.
CHEE 1331	Computing for Engineers	3
CHEE 2331	Chemical Processes	3
CHEM 3331	Fund. of Organic Chem. I	3
MATH 2433	Calculus III	4
POLS 1337	U.S. Government	3
		16

SPRING SEMESTER

Course #	Course	Hrs.
CHEE 2332	Chem. Eng. Thermo. I	3
CHEE 3300	Mat'l Science & Engr.	3
CHEM 3221	Fund. of Org. Chem. Lab	2
CHEM 3332	Fund. of Organic Chem. II	3
MATH 3321	Engineering Mathematics	3
		14

THIRD YEAR

FALL SEMESTER

Course #	Course	Hrs.
CHEE 3333	ChE Thermo. II	3
CHEE 3334	Anal./Numer. Techn.	3
CHEE 3363	Fluid Mech. for ChE	3
PHYS 1322	Engr. Physics II	3
	Humanities Core	3
	Adv. Chem. elective	3
		18

SPRING SEMESTER

Course #	Course	Hrs.
CHEE 3367	Proc. Mod./Control	3
CHEE 3369	ChE Transport Proc.	3
CHEE 3462	Unit Operations	4
CHEE 3466	Bio & Physical Chem.	4
	Social & Behavior Science core	3
		17

FOURTH YEAR

FALL SEMESTER

Course #	Course	Hrs.
CHEE 4321	ChE Design I	3
CHEE 4361	ChE Practices	3
CHEE 4367	Chem. Reaction Eng.	3
HIST 1378/9	US Hist. since 1877	3
	Technical elective	3
	Vis./Perf. Arts core	3
		18

SPRING SEMESTER

Course #	Course	Hrs.
CHEE 4322	ChE Design II	3
CHEE 4366	Biochem Engr or	
CHEE 4300	Mat Sci & Engr II	3
	Technical elective	3
	Adv. Sci. elective	3
	Soc./Beh. Sci.WI core	3
		15

TOTAL UNDERGRADUATE HOURS: 130

// Scholarships //

UNDERGRADUATE SCHOLARSHIP RECIPIENTS

Our undergraduate program enjoys a robust level of support from industrial and organizational donors. Following are the 2001–2002 recipients of these undergraduate scholarships:

BP/AMOCO FOUNDATION

Jason Ellis
José A. Hinojosa
Juan R. Leal
Michael Rauschhuber

LUBRIZOL FOUNDATION

James Aguirre
Mei Yee Khoo
Marsha Thomas-Blades
Cong Trinh

SOUTHWEST CHEMICAL ASSOCIATION

Brooke L. Butts

DONALD F. OTHMER SOPHOMORE ACADEMIC EXCELLENCE AWARD

Ngoc D. Pham

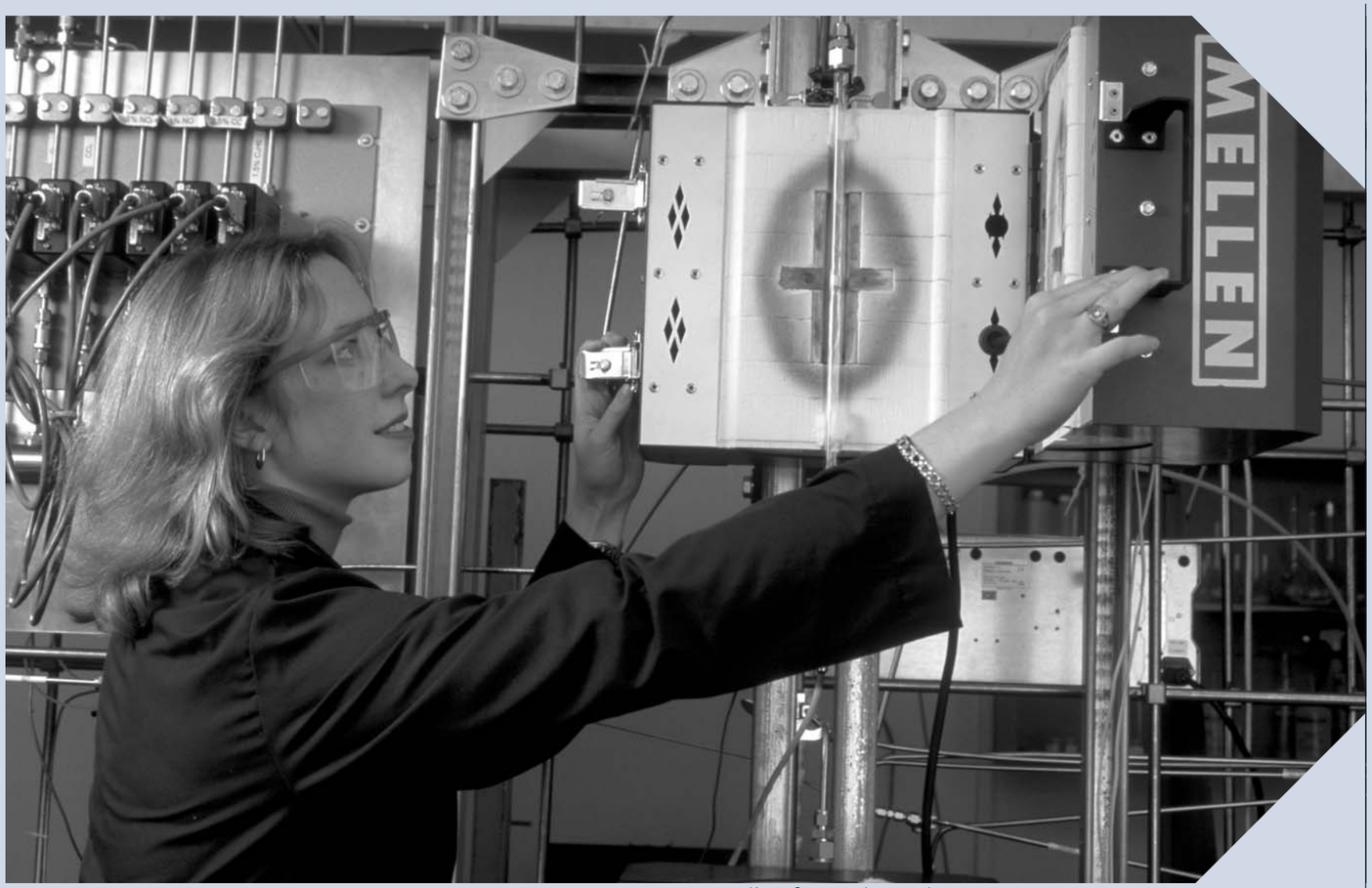
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

(to be announced in March 2003)

UNDERGRADUATE AIChE CHAPTER

The Department has an active undergraduate chapter of the South Texas Section of the American Institute of Chemical Engineers (AIChE). The chapter is advised by Prof. Michael Nikolaou.

THE GRADUATE PROGRAM



Karen Coym, graduate student

The Department offers four graduate programs:

1. **FULL-TIME MS/PHD:** This program supports the research activity of the faculty and is designed for full-time graduate students receiving financial support. Most students pursue the PhD degree, which may be completed (without an intermediate MS) in four years of study.

2. **PART-TIME MS (NON-THESIS OPTION):** Intended for part-time students from local industry who have a BS ChE degree, this program requires 30 semester hours of coursework, including the same core required for full-time MS students.

3. **PART-TIME MCHE:** This is a separate Master's program that emphasizes advanced engineering and business management. Admission and graduation requirements are the same as for the MS degree, but mastery of advanced engineering is the main goal. Approximately 25 students enroll annually. The MChE degree may be completed in four semesters (two years).

4. **MASTERS OF PETROLEUM ENGINEERING:** Similar to the MChE degree, this program offers advanced thesis or non-thesis studies to full- or part-time students in petroleum engineering. Annual enrollments range from 40 to 80 students, with an additional number of postbaccalaureate students involved in the coursework.

Details of these programs, and descriptions of the coursework offered, appear on the pages following.

The CHEMICAL ENGINEERING GRADUATE PROGRAM at the UNIVERSITY OF HOUSTON is among the TOP 20 IN THE NATION (17th in the 1995 National Research Council ratings). Our doctoral program is among the highest-rated doctoral programs in the entire University. This is due to the excellence of our faculty in research, the international reputation of our professors, and the success of our graduates. On the average, our faculty members receive $1 million of support each year, and the Department generally has total overall annual expenditures of approximately $3.5 million for graduate research activities.

// Full-Time Graduate Programs in ChE //

Current areas:

Reaction engineering
Catalytic engineering
Electronic materials
Polymer science and engineering
Biochemical engineering
Colloids & supra-molecular fluids
Advanced inorganic materials
Solid/liquid separations
Petroleum engineering
Multiphase flow
Computer-aided process engineering

FULL-TIME PROGRAMS OF STUDY (REQUIRING A THESIS)

The Department of Chemical Engineering offers Master of Science (MS) and Doctor of Philosophy (PhD) degree programs, both of which focus on advanced engineering fundamentals and research.

Recipients of the MS degree are qualified for employment in industry or for continued studies toward the PhD degree. Coursework for the MS degree includes four specific classes (Engineering Mathematics, Reaction Engineering, Transport Processes, and Classical & Statistical Thermodynamics) and two electives of the student's choice. The student also completes a research project and writes a Master's thesis describing the work. Candidates entering the program with a Bachelor of Science in Chemical Engineering can complete all requirements in 12 to 18 months.

Candidates for the PhD degree enjoy intensive exposure to a specific field of engineering research in addition to continued study of engineering fundamentals. Individual research is the major focal point for these students, who will learn, absorb, and otherwise experience the general philosophy, methods, and concepts of research and scholarly inquiry. After graduation, UH ChE PhD recipients will be qualified to contribute to the solution of significant problems related or unrelated to their doctoral research. For students considering an academic career, instructorships are available. Coursework for the PhD degree includes six specific courses (Engineering Mathematics II, Transport Processes II, and the four courses listed in the preceding paragraph) and six elective courses, which allow for specialization in the student's research area. In addition, all students undertake a doctoral research project and dissertation to expand the frontiers of knowledge in their research areas. Acceptance into this full-time program is generally accompanied by Departmental financial support. Candidates with a BS in Chemical Engineering can complete all requirements in about four years.

A student must pass the PhD Qualifying Exam to be formally accepted as a doctoral candidate. To be eligible to take this examination, a student must have completed the six specifically required PhD courses with a minimum cumulative GPA of 3.0/4.0. There is no foreign-language requirement. Highly qualified students may bypass the MS degree and pursue the doctorate directly.

The ratio of graduate students to faculty is low, typically four to six students per research advisor. After new students have spent their first semester in the Department, the ChE faculty make presentations of their research programs and interests to better enable the students to submit their requests for choice of research advisor. Every reasonable effort is made to accommodate students' first choice of advisor.

RESEARCH AREAS & EQUIPMENT

The Department's research programs are broad and innovative, encompassing traditional and emerging chemical engineering disciplines. Departmental research equipment includes an X-ray diffractometer with a hot stage, a pulsed excimer-pumped dye laser, a quasielastic laser-light-scattering spectroscopy unit, a computerized axial tomographic scanner (CATscan) system, rheometers, a fluorescence-polarization stopped-flow kinetics apparatus, and a titration microcalorimeter. Additionally, the Department houses numerous workstations and personal computers for graduate research. Access to a university VAX network and Hitachi AS/9000N mainframe is also available. For large computations, many faculty have reserved time on various national supercomputers.

ENTRANCE REQUIREMENTS (U.S. STUDENTS)

Admission to the Department's graduate programs is competitive, based on GPAs from undergraduate and graduate studies, GRE scores, and letters of recommendation. The U.S. applicant must generally have achieved a minimum undergraduate GPA of 3.0/4.0 and a minimum GRE score (Verbal + Quantitative) of 1100. Students with undergraduate degrees in fields other than Chemical Engineering may apply, but these students may need to take preparatory courses prior to or concurrently with ChE graduate study.

ENTRANCE REQUIREMENTS (INTERNATIONAL STUDENTS)

The international students offered admission over recent years have ranked in the top 10% of their class, and they have scored over 1200 on the GRE (Verbal + Quantitative) and over 550 on the TOEFL.

International applicants thus qualified should be prepared to submit unofficial copies of GRE scores, TOEFL scores, and transcripts well in advance of the Department's request for official documents. Official GRE and TOEFL scores should then be sent, using ETS Institutional Code 6870. The TOEFL requirement is waived for applicants from primarily English-speaking countries and for applicants who have earned a lesser ChE degree from a U.S. institution. The University of Houston requires a fee of $75 (in U.S. funds) to process graduate applications from non-U.S. citizens.

All applicants (U.S. and international) must also submit a completed University of Houston application form and a Chemical Engineering Department application form. Transcripts and all other documents should be mailed directly to one of the two addresses below, as application requests or components addressed to the UH Office of Admissions frequently fail to reach the Chemical Engineering Department in timely fashion. Note: Incoming UH ChE graduate students are admitted for Fall semesters only. Fall-semester applications that are received by the preceding February 1 are most favorably considered, although later applications may also be considered.

Qualified U.S. and international students may request a complete application package for the full-time, thesis-option MS or PhD programs from the appropriate agent below:

U.S. CITIZENS/PERMANENT RESIDENTS:
Graduate Studies Coordinator
University of Houston
Department of Chemical Engineering
S222 Engineering Bldg 1
Houston, TX 77204-4004

INTERNATIONAL CITIZENS:
International Graduate Coordinator
University of Houston
Department of Chemical Engineering
S222 Engineering Bldg 1
Houston, TX 77204-4004, U.S.A.

FINANCIAL AID

Fellowships that typically consist of a stipend, tuition and fees are available for qualified PhD and full-time MS candidates. These fellowships are awarded on a competitive basis. Applicants may apply for financial assistance when requesting admission to the graduate program.

// Master of Chemical Engineering (MChE) Degree (part-time) //

MASTER OF CHEMICAL ENGINEERING (MCHE) DEGREE

The MChE degree is a non-thesis program for the working professional. This program has been designed for those persons who plan careers in plant operations, design, and management. It is intended to be competitive neither with the Master of Science degree (which is specifically research-oriented) nor with an MBA degree. Rather, the goal of this program is to permit earlier productive use of young engineers' technical skills and to impart broad concepts of systems analysis, advanced process economics, and technical management. The program is aimed at improving opportunities for chemical engineers in chemical-process and related industries.

The program comprises a core of six required courses, plus four elective courses selected to meet the student's interests in the areas of process control, management and business economics, biochemical and environmental engineering, and petroleum engineering. The courses are available in the late afternoon and evenings, and the degree program can be completed in two to three years of part-time study.

Entrance requirements include a Bachelor's degree in Chemical Engineering, industrial employment, and approvals of the MChE Program Director, the Chairman of the Chemical Engineering Department, and the Dean of Engineering. Unconditional admission may be granted for a minimum undergraduate GPA of 3.0 (4.0 scale) and a minimum GRE score (verbal + quantitative) of 1100. Conditional admission may be granted for a minimum undergraduate GPA of 2.6/4.0 and a minimum GRE of 1000, with special permission of the Program Director and the Dean of Engineering. Achievement of a grade of "B" or better in the first 12 hours of coursework removes the conditional status.

For complete information, prospective students should contact the MChE Program Director:

Prof. Kishore K. Mohanty
University of Houston
Chemical Engineering
S222 Engineering Bldg. 1
Houston, TX 77204-4004

// Master of Science in Petroleum Engineering (MSPE) //

MASTER OF SCIENCE IN PETROLEUM ENGINEERING

The MSPE degree is ideal for any engineering graduate who desires to begin working or to improve his position in the upstream petroleum industry. This program offers courses held 5:30–8:30 p.m. Monday through Thursday, enabling attendance after business hours for full-time professionals.

Students may elect whether to complete the Nonthesis Option, which requires 30 credit hours of approved courses beyond the introductory level in Petroleum Engineering, or the Thesis Option, which requires 18 credit hours of approved courses beyond the introductory level in Petroleum Engineering plus 12 credit hours dedicated to the Master's thesis. Petroleum Engineering courses can also be taken for Continuing Education credit, and they can be applied as Professional Development Hours for maintaining professional competency for the Professional Engineer (PE) certification.

A Bachelor's degree in Engineering from an accredited institution is normally required for admission to the MSPE program. Undergraduate degrees in Petroleum, Chemical, or Mechanical Engineering provide all or most of the prerequisite courses for this program. Holders of other scientific degrees, as well as some Engineering graduates, must complete prerequisite requirements. All candidates should have credit for courses equivalent to the University of Houston's prerequisites for this degree.

For unconditional admission to the program, a minimum undergraduate GPA of 3.0 (4.0 scale) and an acceptable GRE score (verbal + quantitative) are required. For conditional admission, a minimum undergraduate GPA of 2.6, an acceptable GRE score, and special consent of the Program Director and the Dean of Engineering are required. International applicants must qualify for unconditional admission and satisfy the University of Houston's requirement of a minimum TOEFL score of 550.

Once accepted into the graduate program, part-time students will be advised how to schedule courses sufficient for the MSPE degree program. (Part-time students commonly take one or two courses per semester.) Full-time students will be advised how to complete the required courses within a period of 1.5 years.

For application forms, contact the Program Director. All correspondence and supporting documents (official transcripts and test scores) should also be mailed to this address:

Dr. Christine A. Economides
University of Houston
Chemical Engineering
S222 Engineering Bldg 1
Houston, TX 77204-4004

// Graduate Courses //

CHEMICAL ENGINEERING (CHEE)

6111: Graduate Seminar Cr. 1 (1-0). May be repeated for credit.

6197:6297:6397: Selected Topics Cr. 1-3 per semester (1-0; 2-0; 3-0). May be repeated for credit.

6198:6298:6398:6498:6598: Research Cr. 1-5 per semester, or more by concurrent enrollment. *Prerequisite:* approval of Chairman.

6289:6389: Chemical Engineering Project Cr. 2 or 3 per semester (2-0; 3-0). *Prerequisite:* approval of instructor. May be repeated for credit. Industrial-scale chemical engineering economics and/or engineering project.

6330: Computational Methods for Chemical Engineers Cr. 3 (3-0). *Prerequisite:* consent of instructor. Advanced computational and numerical methods for the solution of chemical engineering problems. Solution of linear and nonlinear equations. Conjugate-gradient-like methods. Newton and quasi-Newton techniques. Solutions of elliptic and hyperbolic partial differential equations using finite-difference and finite-element techniques. Applications to chemical engineering problems.

6331:6332: Mathematical Methods in Chemical Engineering Cr. 3 per semester (3-0). *Prerequisite:* approval of Department. Linear methods applied to chemical engineering, matrices, transforms, series, complex variable methods, boundary-layer problems.

6333:6334: Transport Processes Cr. 3 per semester (3-0). *Prerequisite:* CHEE 3369. Advanced principles of fluid mechanics and heat/mass transfer, with application to problems in research and design. Emphasis on unified point of view to transport processes in laminar- and turbulent-flow situations.

6335:6336: Classical & Statistical Thermodynamics Cr. 3 per semester (3-0). *Prerequisite:* CHEE 3460. Advanced methods.

6337: Advanced Reactor Engineering Cr. 3 (3-0). *Prerequisite:* undergraduate kinetics or reactor-design course. Introduction to modern concepts and techniques of chemical-reactor analysis and design.

6360: Biochemical Engineering Fundamentals Cr. 3 (3-0). *Prerequisite:* graduate standing, or senior with consent of instructor. Analysis and design fundamentals for biochemical processes: introductory biochemistry, microbiology, biological kinetics, reactor design, transport phenomena; applications of enzymes and single mixed microbial populations.

6365: Fundamentals of Catalysis Cr. 3 (3-0). *Prerequisite:* CHEE 4367 or equivalent. Theories and experimental procedures in modern heterogeneous catalysis, catalyst preparation and properties, absorption, surface mechanisms, catalyst design, and catalytic processes.

6367: Advanced Process Control Cr. 3 (3-0). *Prerequisite:* CHEE 3367 or equivalent, or consent of instructor. Application of high-speed computers in the control of chemical processes, reactors, and units.

6368: Chemical Process Economics I Cr. 3 (3-0). *Prerequisite:* graduate standing in chemical engineering and CHEE 6350. Managerial economics of chemical processes and products; development of decision-making methods using examples from the chemical industry.

6369: Chemical Process Economics II Cr. 3 (3-0). *Prerequisites:* CHEE 6350, 6368. Study of profitability, process-comparison, and risk analysis from an advanced viewpoint, followed by extensive case-history studies of managerial economics in process industries.

6370: Advanced Topics in Biochemical Engineering Cr. 3 (3-0). *Prerequisite:* CHEE 6360, or consent of instructor. Mathematical modeling and optimization of separation-unit operations in biochemical engineering, including chromatography, flocculation, centrifugation, and filtration. Engineering analysis and design of mammalian-cell bioreactors.

6371: Pollution-Control Engineering Cr. 3 (3-0). *Prerequisite:* Credit for or concurrent enrollment in CHEE 4321 and 4367 or equivalent. General survey of problems and remedies with the Earth as an environmentally closed system. Limitations of absorption and self-cleansing of the terrasphere, hydrosphere and atmosphere, and their interaction and interrelationship.

6372: Fluid/Particle Separation Cr. 3 (3-0). *Prerequisite:* ENGI 3363 or equivalent. Introduction to heterogeneous, fluid/particle, multiphase systems. Development of fundamental principles of flow through compactible beds. Application to solid/liquid separation. Brief study of aerosols, coalescence, and flotation.

6373: Environmental Remediation Cr. 3 (3-0). *Prerequisites:* ENGI 3363, CHEE 3462, and credit for or concurrent enrollment in CHEE 4367. In situ and ex situ methods of remediation or restoration of contaminated environmental sites. Emphasis is on hydrocarbon contaminants in soil, surface water, and groundwater.

6374: Reaction Kinetics for Industrial Processes Cr. 3 (3.0). *Prerequisite:* credit for or concurrent enrollment in CHEE 4367. Fundamental methods for predicting product distributions in practical chemical reactors. Determination of thermochemical and kinetic constants from statistical mechanics and transition-state theory. Applications from vapor-phase processes to catalysis.

6375: Chemical Processing for Microelectronics Cr. 3 (3-0). *Prerequisites:* CHEE 4367 or equivalent, or consent of instructor. Chemical Engineering principles applied to microelectronic-device fabrication and processing.

6376: Solid/Liquid Separation—Environmental Processes Cr. 3 (3-0). *Prerequisite:* ENGI 3363. Introduction to solid/fluid separation and processing. Particulate characteristics, porous media, interfacial phenomena, flow through compactible and granular beds; sedimentation, clarification, filtration, centrifugation, expression, washing.

6377: Introduction to Polymer Science Cr. 3 (3-0). *Prerequisite:* consent of instructor. Introduction to the synthesis, characterization, physical properties, and processing of polymeric materials. Methods to measure, characterize, and tailor structure-processing-property correlations for polymeric materials.

6379: Safety & Reliability Cr. 3 (3-0). *Prerequisites:* CHEE 3363, 3367, 3369. Overview of risks, safeguards, and hazards associated with chemical process engineering. Layers of protection, hazard identification, source-term models, toxic release and dispersion models, fires and explosions, probabilistic analysis, fault-tree analysis, designs to prevent accidents, safety-instrumented systems, and safety-related standards and regulations.

6380: Biochemical Separations Cr. 3 (3-0). *Prerequisite:* Senior standing in Chemical Engineering, or consent of instructor. Producing a cloned protein in useful amounts; use of recombinant DNA methodologies to produce proteins; characterization methods.

6383: Advanced Unit Operations Cr. 3 (3-0). *Prerequisite:* CHEE 3462. Property-prediction of multi-component fluids. Advanced principles of heat-exchanger design, multicomponent fractionation, absorption, stripping, and extraction from a unified point of view.

6384: Petrochemical Processes Cr. 3 (3.0). *Prerequisite:* consent of instructor. Description of the petrochemical industry in terms of products, feedstocks, companies, and future trends. Markets, technology, and economics are provided for each of the major building blocks and derivatives to the end products.

6386: Air-Pollution Problems & Control Cr. 3 (3-0). *Prerequisite:* consent of instructor. Air-pollutant identification and control technology; estimation of pollutant transport, dispersion, and conversion; computer application for design of control units.

6388: Catalytic Processes Cr. 3 (3-0). *Prerequisite:* Credit for or concurrent enrollment in CHEE 4321 and 4367. Process-oriented survey of catalytic technology; catalyst selection and design; catalytic processes, engineering, and economics in the petroleum, chemical, and pollution-control industries.

6399-7399: Master's Thesis Cr. 3 per semester.

7350: Applied Nonlinear Methods for Engineers Cr. 3 (3-0). *Prerequisite:* CHEE 6331, 6332, or consent of instructor. Recent nonlinear methods, with emphasis on Engineering applications. Nonlinear functional analysis, steady-state bifurcation theory, dynamical systems, nonlinear partial differential equations, nonlinear waves, computation methods in bifurcation theory.

7387: Plasma Processing: Principles & Applications Cr. 3 (3-0). *Prerequisite:* graduate standing in Engineering or Natural Sciences, or consent of instructor. Principles of low-pressure glow-discharge plasma; plasma generation and maintenance; plasma chemistry; plasma diagnostics. Applications with emphasis on semiconductor manufacturing.

7397: Selected Topics Cr. 3 per semester (3-0). May be repeated for credit.

PETROLEUM ENGINEERING (PETR)

5361: Introduction to Petroleum Engineering Cr. 3 (3-0). *Prerequisite:* senior, post-baccalaureate, or graduate standing in Engineering or Geology. Petroleum origin and migration, major oil and gas fields, drilling and production methods, petroleum composition and phase behavior, reservoir-engineering methods of oil-resource estimation and optimization.

5362: Reservoir Engineering I Cr. 3 (3-0). *Prerequisite:* senior, postbaccalaureate, or graduate standing in Engineering or Geology. Rock and fluid properties and interactions, P-V-T behavior of crude oil and natural gas, fundamentals of fluid flow through subsurface porous media, reservoir-energy mechanisms in recovery, material balance, and reserves estimation.

5364: Origin & Development of Oil & Gas Reservoirs Cr. 3 (3-0). *Prerequisite:* senior, post-baccalaureate, or graduate standing in Engineering. Major oil provinces of the world reviewed from the standpoints of geologic and depositional environment, and of diagenetic changes affecting petroleum entrapment.

5368: Well-Drilling & Completion Cr. 3 (3-0). *Prerequisite:* senior, postbaccalaureate, or graduate standing in Engineering or Science. Drilling-rig design and operation; drilling programs; drill string and bit designs; drilling-mud composition, properties, and functions; casing design and cementing; methods of well-completion.

5370: Petroleum-Production Operations Cr. 3 (3-0). *Prerequisite:* senior, postbaccalaureate, or graduate standing in Engineering or Science. Subsurface and surface facilities for producing oil and gas; gas-oil and water-oil separation and measuring systems; gathering systems; gas-processing facilities; injection systems for gas or water.

5397: Selected Topics Cr. 3 (3-0). May be repeated for credit when topics vary.

6298:6398:6498:6598: Research Cr. 2–5 per semester, or more by concurrent enrollment. *Prerequisite:* approval of Chairman.

6302: Reservoir Engineering II Cr. 3 (3-0). *Prerequisites:* PETR 5361 and 5362, or consent of instructor. Capillary pressures and vertical distribution of gas, oil, and water saturations, relative permeability and fractional flow relationships, Buckley-Leverett equation and linear-displacement efficiency of gas and water drives; effect of well patterns, mobility ratio, and reservoir heterogeneity on areal and vertical-sweep-efficiency performance of black-oil reservoirs.

6304: Evaluation of Petroleum-Bearing Formations I Cr. 3 (3-0). *Prerequisites:* PETR 5361 & 5362, or consent of instructor. Characterization of formations by geologic and petrographic examination, by analysis of fluid contents of cores, and by a suite of well-logging tests and their combined interpretation.

6306: Oilfield Facilities Design & Operation I Cr. 3 (3-4). *Prerequisites:* PETR 5361, 5368, and 5370, or consent of instructor. Design and operating principles of gas and water-surface separation and ratio-testing equipment, water-supply and water-disposal systems, gas-dehydration and -purification systems, gas compression, corrosion control, and clathrate prevention.

6308: Advanced Petroleum-Production Operations Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5368, and 5370, or consent of instructor. Inflow performance relationships for oil, two-phase, and natural-gas wells; near-well zone and damage; vertical-lift performance; well-delivery. Forecast of well performance; methods of diagnosis of well performance. Well-testing and production-logging; well stimulation by acid treatments and hydraulic fracturing. Artificial lift (gas- and pump-assisted). Systems analysis.

6310: Petroleum-Production Economics I Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5362, and 6302, or consent of instructor. Estimation of initial reservoir contents and forecasts of production vs. time of crude oil and natural gas by primary, secondary, and tertiary recovery methods, evaluation of costs and risks vs. expected rewards by alternative recovery methods, measures of profitability by discounting and cash-flow calculations, effects of taxation, and external financing.

6312: Evaluation of Petroleum-Bearing Formations II Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5362, and 6304, or consent of instructor. Advanced well-log interpretation and logging-tool theory. A continuation of PETR 6304 (Evaluation of Petroleum-Bearing Formations I).

6314: Pressure-Transient Testing Cr. 3 (3-0). *Prerequisites:* PETR 5362 and 6302. Theory and application of pressure-transient testing of oil and gas wells for determination of reservoir properties and near-well damage or stimulation.

6316: Well Drilling & Completion II Cr. 3 (3-0). *Prerequisites:* PETR 5368 and graduate standing in petroleum engineering. Principles and procedures for cost-effective casing design; materials, design, and procedures for cementing; optimization of bits, weight, and R.P.M. for minimum cost for drilling; directional drilling.

6318: Oilfield Facilities Design & Operation II Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5370, and 6306. Design theory and practice for facilities for unusual situations as may be required of practicing engineers; adaptations for offshore and other hostile environments.

6320: Enhanced Oil-Recovery Processes Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5362, and 6302, or consent of instructor. Review of waterflood-calculation methods, extension to polymer flooding, caustic flooding, and carbonated-water flooding. Hydrocarbon-miscible flooding and CO flooding; estimation of recovery.

6324: Theory of Reservoir Modeling Cr. 3 (3-0). *Prerequisites:* PETR 5361, 5362, and 6302, or consent of instructor. Survey of reservoir-simulation methods, stream-tube simulator, finite-difference, finite-element, and collocation methods. Theory of finite-difference simulators; formulation of equations and resulting matrices, alternative solution methods.

6325: Integrated Reservoir Characterization Cr. 3 (3-0). *Prerequisites:* Senior, postbaccalaureate or graduate standing in engineering or science. Focuses on modern reservoir-characterization techniques, including pixel-based and object-based geostatistical methods designed to capture the influence of geology on fluid flow and storage.

6326: Applied Reservoir Simulation Cr. 3 (3-0). *Prerequisite:* PETR 6324, or consent of instructor. Application of reservoir simulators to demonstrate effects of reservoir characteristics on oil recovery by a variety of processes. Simplified representation of complex reservoir structures by use of cross-sections and areal models with pseudo-functions.

6350: Natural-Gas Engineering Cr. 3 (3-0). *Prerequisites:* PETR 5362, 6328, or consent of instructor. Comprehensive study that focuses on natural-gas engineering, the energy situation today, and the emerging technologies of tomorrow. Covers the supply of natural gas, including exploration, production, unconventional resources, transportation, processing, conversion, and fuel cells.

6387: Drilling & Completion of Complex Well Architectures Cr. 3 (3-0). *Prerequisites:* PETR 6316, 6368. Examination of the most recent well-construction technologies and the reservoir characteristics required for designing horizontal and multibranch wells. Description of specialized drilling strategies, including extended reach, underbalance, coiled tubing, and geosteering.

6388: Petroleum Engineering Project Cr. 3 per semester (3-0). *Prerequisites:* PETR 5361, 5362, 5368, and 5370, or consent of the project advisor. May be repeated once for credit.

6397: Selected Topics in Petroleum Engineering Cr. 3 (3-0). May be repeated for credit.

7397: Selected Topics Cr. 3 (3-0). May be repeated for credit.

// Graduate Student Organization //

ORGANIZATION OF CHEMICAL ENGINEERING GRADUATE STUDENTS (OCHEGS) is an educational and social student group that supplements formal departmental activities and functions. As part of the Department's weekly seminar program (*q.v.*), OChEGS annually organizes and conducts an all-day symposium, featuring keynote speakers specially recruited from industry, academia, or government. At the symposium, several students give oral presentations of their research while others display posters. The organization holds social events (picnics, get-togethers for sports, *et al.*), and elects officers annually.

Corporate sponsors of the 2001 OChEGS Symposium, to whom the Department and OChEGS are most grateful, were: BP Chemicals; Cutler Johnston Corporation; ExxonMobil Chemical Co.; ExxonMobil Upstream Research; Halliburton; Shell International; and Stone Bond Corporation. Additional support was provided by the University of Houston Chemical Engineering Department and the University of Houston Activities Funding Board.

Here is the technical program of the 16th-annual Chemical Engineering Graduate Students' Symposium (Fall 2001). Luigi Saputelli presided as OChEGS President:

Friday, 26 October 2001

7:30 – 8:30 a.m.	Registration & Breakfast
8:30 – 8:40 a.m.	Opening Remarks
8:40 – 9:25 a.m.	*Keynote Speaker:* **Dr. Bob Heinemann**, Chief Technology Officer, Halliburton, "Technology in the Oil & Gas Industry: Does It Make a Difference?"
9:30 – 9:55 a.m.	**Sathish Sankaran**, "Plant-Friendly Assessment of Model Quality in Model-Predictive Control Systems"
9:55 – 10:20 a.m.	**Dr. Oleg Galkin**, "Liquid-Liquid Phase Boundary and Protein Homogeneous Nucleation Ratest"
10:20 – 10:30 a.m.	Coffee Break
10:30 – 10:55 a.m.	**Irwan Hidajat**, "Study of Carbonate Morphology by using X-ray, CT-scanner, & NMR"
10:55 – 11:20 a.m.	**Jinxia Deng**, "MUSIC Simulations on Molecular-Dynamics Structures of the HIV-1 Integrase to Develop a Dynamic Pharmacophore Model for Anti-AIDS Drug Design"
11:20 – 1:00 p.m.	Lunch & Poster Session
1:00 – 1:25 p.m.	**Dr. Wenping Li**, "Pressure Filtration of Supercompactible Materials"
1:25 – 1:50 p.m.	**Bharat Marwaha**, "Formation & Dynamics of Hot Regions in Packed-Bed Reactors"
1:50 – 2:15 p.m.	**Jiaxiang Ren**, "Viscoelastic Properties of Layered-Silicate-Based Polymer Nanocomposites"
2:15 – 2:25 p.m.	Coffee Break
2:25 – 2:50 p.m.	**Mohammad Shafiei**, "Catalytic Steam-Reforming for Detoxification of Chlorocarbons"
2:50 – 3:15 p.m.	**Dimitris Sagias**, "Closed-Loop Identification of Processes Operating under Model-Predictive Control"
3:15 – 3:40 p.m.	**Eric K. Dao**, "Modeling & Experimental Studies of Wave Occlusion in Falling Films in Vertical Pipes"
3:40 p.m.	Reception

// Weekly Seminar Series //

The Department attracts renowned speakers to address our graduate students on virtually a weekly basis. These speakers provide lecture abstracts that are distributed not just intradepartmentally, but to key industrial and academic figures statewide who may wish to attend. Unless exceptional circumstances apply, all ChE seminars are held on Fridays at 10:30 a.m. in room W122 of Bldg. D3, Cullen College of Engineering.

These seminars were presented in 2001–2002:

SPRING SEMESTER 2001

JANUARY 9: **Dr. James Wei**, *Dean of Engineering & Applied Sciences, Princeton University (Princeton, NJ):* Second Annual Neal R. Amundson Lecture—"The Third Paradigm of Chemical Engineering: Molecular-Product Engineering"

JANUARY 19: **Prof. H.H. Rotermund**, *Department of Physical Chemistry, Fritz-Haber-Institut der Max-Planck-Gesellschaft (Berlin, Germany):* "Shedding Light on Surface Reactions: Imaging Pattern Formations from Ultra-High Vacuum up to High Pressure"

JANUARY 26: **Prof. Jennifer L. West**, *Chemical Engineering & Bioengineering Department, Rice University (Houston, TX):* "Synthetic ECM Analogs: New Biomaterials for Use in Tissue Engineering"

FEBRUARY 2: **Prof. Michael V. Pishko**, *Chemical Engineering Department, Texas A&M University (College Station, TX):* "Microscale & Nanoscale Hydrogels for Chemical Sensing"

FEBRUARY 9: **Prof. Donald Dabdub**, *Mechanical & Aerospace Engineering Department, University of California (Irvine, CA):* "Mathematical Modeling of Size- & Chemically Resolved Urban Atmospheric Aerosols"

FEBRUARY 16: **Prof. Peter G. Vekilov**, *Chemistry Department, University of Alabama (Huntsville, AL):* "Phase Transitions in Protein Solutions: Structures, Dynamics, & Control Strategies"

FEBRUARY 23: **Dr. Alan W. Mahoney**, *School of Chemical Engineering, Purdue University (West Lafayette, IN):* "Inverse-Problem Modeling of Particulate Dynamics"

MARCH 2: **Dr. Victor M. Ugaz**, *Chemical Engineering Department, University of Michigan (Ann Arbor, MI):* "Investigation of the Interplay between Structure & Rheology in Model Thermotropic Liquid Crystal Polymers using in situ X-ray Scattering Techniques"

MARCH 9: **Emmanouhl S. Tzanakakis**, *Chemical Engineering & Materials Science Department, University of Minnesota (Minneapolis, MN):* "Tissue Engineering through Hepatocyte Spheroid Self-Assembly"

MARCH 23: **Dr. Michael R. King**, *Chemical Engineering Department, University of Pennsylvania (Philadelphia, PA):* "The Dynamics of Leukocyte Adhesion in a Multicellular Environment"

MARCH 30: **Prof. Gilbert F. Froment**, *Chemical Engineering Department, Texas A&M University (College Station, TX):* "Synthesis-Gas Production by Steam/CO2 Reforming & Catalytic Partial Oxidation of Natural Gas"

APRIL 6: **Maria I. Klapa**, *Chemical Engineering Department, Massachusetts Institute of Technology (Cambridge, MA):* "High-Resolution Flux Determination using Stable Isotopes & Mass Spectrometry"

APRIL 27: **Aaron J. Golumbfskie**, *Chemical Engineering Department, University of California (Berkeley, CA):* "Simulation of Biomimetic Recognition between Polymers & Surfaces"

JUNE 11: **Prof. J.B. Joshi**, *Department of Chemical Technology, University of Mumbai (Matunga, Mumbai, India):* "Computational Flow Modeling & Design" (cancelled due to the local flooding from Tropical Storm Allison).

FALL SEMESTER 2001

SEPTEMBER 7: **Prof. Bala Subramaniam**, *Chemical Engineering Department, University of Kansas (Lawrence, KS):* "Catalysis in Supercritical Reaction Media"

SEPTEMBER 14: **Prof. Kyriacos Zygourakis**, *Chemical Engineering Department, Rice University (Houston, TX):* "Tissue Regeneration & Wound-Healing: Experimental & Computational Approaches"

OCTOBER 5: **Prof. Moshe Sheintuch**, *Chemical Engineering Department, The Technion (Haifa, Israel):* "Flow Effects on Spatiotemporal Patterns Emerging in Catalytic Systems"

OCTOBER 19: **Prof. Dennis W. Hess**, *School of Chemical Engineering, Georgia Institute of Technology (Atlanta, GA):* "Plasma Polymerization of Low-Dielectric-Constant Fluorocarbon Films"

OCTOBER 25: **Dr. Vincent M. Donnelly**, *Agere Systems (Murray Hill, NJ):* "Studies of Chlorine Plasmas & Silicon Etching"

NOVEMBER 16: **Prof. Jennifer Sinclair**, *School of Chemical Engineering, Purdue University (West Lafayette, IN):* "Effects of Solids Loading in Dilute & Dense Gas-Solid Flows"

SPRING SEMESTER 2002

JANUARY 11: **Dr. Dimiter N. Petsev**, *Center for Microgravity & Materials Research, University of Alabama at Huntsville (Huntsville, AL):* "Molecular Interactions & Phase Behavior in Protein Solutions"

JANUARY 18: **Dr. John H. Seinfeld**, *Chemistry & Chemical Engineering Division, California Institute of Technology (Pasadena, CA):* Third Annual Neal R. Amundson Lecture—"Aerosols & Climate"

JANUARY 25: **Lingchong You**, *Chemical Engineering Department, University of Wisconsin (Madison, WI):* "From Bacteriophage T7 to 'Phenobank': Mathematical Modeling for Integrated Understanding of Biological Systems"

FEBRUARY 1: **Dr. Yung Sung Cheng**, *Lovelace Respiratory Research Institute (Albuquerque, NM):* "Pharmaceutical Aerosols: Development of Better Delivery Systems"

FEBRUARY 8: **Aaron Sin**, *Chemical Engineering Department, Cornell University (Ithaca, NY):* "Development of a Microscale Cell-Culture Analog Device"

FEBRUARY 18 (Mon.)**:** **Dr. Cameron F. Abrams**, *Max-Planck-Institut for Polymer Research (Mainz, Germany):* "Molecular & Materials Simulation: From Semiconductors to Polymers"

FEBRUARY 22: **Prof. Paul E. Laibinis**, *Chemical Engineering Department, Massachusetts Institute of Technology (Cambridge, MA):* "Tailoring Surfaces for Adsorption of Halides, DNA, & Other Species: New Approaches for Chemical Sensing & Delivery"

MARCH 1: **Rachel A. Segalman**, *Chemical Engineering Department, University of California at Santa Barbara (Santa Barbara, CA):* "Controlling Long-Range Order for Nanopatterning with Block Copolymers"

MARCH 5 (Tues.)**:** **Dr. Flor R. Siperstein**, *Chemical Engineering Department, North Carolina State University (Raleigh, NC):* "Simulation of Surfactant-Templates of Nanoporous Materials"

MARCH 15: **Dr. Vassilios I. Sikavitsas**, *Chemical Engineering Department, Rice University (Houston, TX):* "Bioreactor Design for Bone Tissue-Engineering"

MARCH 27: **Dr. Adam T. Capitano**, *Chemical Engineering Department, Massachusetts Institute of Technology (Cambridge, MA):* "Design of a Liver-Tissue-Based Toxin Sensor"

FALL SEMESTER 2002

AUGUST 30: **Prof. Greg McKenna**, *Chemical Engineering Department, Texas Tech University (Lubbock, TX):* "Everything (or almost) You Always Wanted to Know about the Glass Transition, but were Afraid to Ask"

SEPTEMBER 6: **Prof. Plamen B. Atanassov**, *Chemical & Nuclear Engineering Department, University of New Mexico (Albuquerque, NM):* "Enzyme-Catalyzed Direct Electron Transfer: Applications in Sensor & Power Sources"

SEPTEMBER 11 (Wed.)**:** **Prof. David Glasser**, *School of Process & Materials Engineering, University of the Witwatersrand (Johannesburg, South Africa):* "Distilling New Ideas from Old: Separation-System Synthesis"

SEPTEMBER 13: **Prof. A. Daniel Hill**, *Petroleum & Geosystems Engineering Department, University of Texas (Austin, TX):* "Acidizing of Naturally Fractured Carbonate Formations"

SEPTEMBER 20: **Dr. Yoram Shoham**, *Vice-President, Shell International E&P (Houston, TX):* "Energy Globalization & Technology Renaissance"

SEPTEMBER 27: **Dr. Akhil Bidani**, *UT Health Sciences Center (Houston, TX):* "Biomedical Engineering at the Interface of Physiology & Medicine"

OCTOBER 11: **Prof. Yannis Kevrekidis**, *Chemical Engineering Department, Princeton University (Princeton, NJ):* "Equation-Free Multiscale Computation: Enabling Microscopic Simulators to Perform System-Level Tasks"

OCTOBER 18: **17th-Annual OChEGS Symposium**

OCTOBER 25: **Prof. Orlin D. Velev**, *Chemical Engineering Department, North Carolina State University (Raleigh, NC):* "Functional Materials & Devices via Electrically Driven Assembly of Colloidal Particles"

NOVEMBER 1: **Prof. Calvin H. Bartholomew**, *Chemical Engineering Department, Brigham Young University (Provo, UT):* "Hydrothermal Degradation of Cobalt Fischer-Tropsch Catalysts"

NOVEMBER 15: **Prof. Roger T. Bonnecaze**, *Chemical Engineering Department, University of Texas (Austin, TX):* "Microstructure Formation by Adsorption of Colloidal & Nanoscale Particles"

NOVEMBER 22: **Prof. Paul H. Steen**, *Chemical Engineering Department, Cornell University (Ithaca, NY):* "Interface Instability & Capillary Micro-Switches"

DECEMBER 6: **Prof. Demetre Economou**, *Chemical Engineering Department, University of Houston:* **Sigma Xi Lecture**—"All in a Grain of Sand: The Microelectronics Revolution"

// Continuing Education //

The following fee-basis Continuing Education course is presented semiannually (generally in May and December) by a team of UH ChE professors and outside experts:

"APPLICATIONS OF HETEROGENEOUS CATALYSIS"

INSTRUCTORS:

Prof. Dan Luss (University of Houston)

Prof. James T. Richardson (University of Houston)

Prof. Joe W. Hightower (Rice University)

Dr. Vern W. Weekman, Jr. (Retired Director, Central Research, Mobil R&D Corporation)

HIGHLIGHTS OF THE COURSE DESCRIPTION:

Successful applications of the principles of catalysis to process design require a combination of physics, chemistry and engineering, together with state-of-the-art "know-how." Contemporary catalysis has made significant progress in recent years toward the scientific design of optimal catalyst systems for specific process requirements. The purpose of this course is to cover current knowledge for both the researcher in catalysis and the engineer interested in process applications. It will serve as a review for those knowledgeable in the subject and as an introduction to newcomers to the field.

The course considers how to select, prepare, characterize, test, and use a catalyst. Both laboratory and commercial methods of catalyst preparation are reviewed, with emphasis on practical applications. Modern instrumental methods for the characterization of catalysts' physical and chemical properties are also included. Techniques for the measurement of surface areas, pore properties, diffusivities, crystallite sizes, acidities, etc. are discussed. All aspects of catalytic kinetics, both chemical and diffusional, are considered with reference to specific problems. Common mechanisms and their relationship to catalyst properties are outlined fully.

To inquire about course dates, registration, and fees, contact:

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