ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΣΧΟΛΗ ΧΗΜΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

ΕΠΙΤΡΟΠΗ ΣΕΜΙΝΑΡΙΩΝ, Καθηγητής Α. Κοκόσης

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ΣΕΜΙΝΑΡΙΟ ΧΗΜΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Πέμπτη 5 Μαΐου 2011, 13:00
Αίθουσα Σεμιναρίων «Ν. Κουμούτσου»

Professor **Christodoulos A. Floudas**

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Hybrid Biomass, Coal, and Natural Gas to Liquids (CBGTL) Systems: Design, Simulation, Process Synthesis, and Supply Chain Optimization

Heavy dependence on petroleum and high greenhouse gas (GHG) emissions from the production, distribution, and consumption of hydrocarbon fuels pose serious challenges for the United States (US) transportation sector. Depletion of domestic petroleum sources combined with a volatile global oil market prompt the need to discover alternative fuel-producing technologies that utilize domestically abundant sources. The primary aim in the discovery of hybrid energy processes is to combine coal, biomass, and natural gas to meet the United States transportation fuel demand. The first part of this presentation will outline the needs and introduce novel coal, biomass, and natural gas to liquids (CBGTL) hybrid energy process alternatives which employ the reverse water-gas-shift reaction along with a non-carbon based source of hydrogen, and attain a near 100% conversion. Mathematical models for biomass and coal gasification are developed to model the non-equilibrium effluent conditions using a stoichiometry-based method. Steady-state process simulation results coupled with heat and power integration, and economic analysis determine the break-even price of crude oil (BEOP) and suggest that the CBGTL process is competitive with petroleum-based processes.
The second part of the presentation will address important decisions at the process synthesis level. A thermochemical based process superstructure and its mixed-integer nonlinear optimization (MINLP) model will be discussed.

Simultaneous heat, power and water integration takes place at the process synthesis stage. Case studies will be presented to investigate the effect of CO2 sequestration (CCS) and GHG reduction targets on the process topology.

The third part will present a novel framework for the optimal energy supply chain of CBGTL processes. A mathematical model will be introduced that minimizes the total network cost while simultaneously evaluates the environmental performance through a life cycle analysis of each individual plant. The optimal network topology provides information on (i) the optimal plant locations throughout the country, (ii) the locations of feedstock sources, (iii) the interconnectivity between the feedstock source locations, CBGTL plants locations, and the demand locations, (iv) the modes of transportation used in each connection, and (v) the flow rate amounts of each feedstock and product type.