CHEMICAL REACTION ENGINEERING - II

Prof. GANESH VISWANATHAN
Department of Chemical Engineering
IIT Bombay

INTENDED AUDIENCE : Chemical Engineering, Energy Engineering, Environmental Engineering, Petrochemical engineering, Biotechnology

PREREQUISITES : Linear algebra, First course in reaction engineering, Heat and mass transfer

INDUSTRY SUPPORT : Reliance, HPCL, BPCL, RCF, Other chemical, pharmaceutical and petrochemical companies

COURSE OUTLINE :

Multiphase catalytic and non-catalytic reactors are ubiquitously found in chemical, biochemical and petrochemical industries for manufacturing variety of useful products. Effective design of such reactors for improved productivity requires detailed understanding of the underlying principles that govern their functioning. This second level course on chemical reaction engineering will extensively cover design of fluid-solid catalytic and non-catalytic reactors. Moreover, residence time distribution is an important aspect that is often used for various fault-diagnosis purposes. This course also covers various aspects of RTD and its applicability in designing reactors. The material covered in this course will build on the basic topics of the first level chemical reaction engineering course.

ABOUT INSTRUCTOR :

Prof. Ganesh Viswanathan is an Associate Professor in Department of Chemical Engineering at Indian Institute of Technology Bombay, Mumbai. He completed his Ph.D in Chemical Engineering from University of Houston, Houston and Postdoctoral Fellowship at Mount Sinai School of Medicine, New York. He conducts research in systems biology of signaling networks and nonlinear dynamics of reactors. Further information about his research and teaching activities is available at http://www.che.iitb.ac.in/faculty/ganesh/

COURSE PLAN :

Week 1 : Introduction, Introduction to catalysis and catalytic processes, Catalyst properties and classification, Steps in catalysis, Adsorption isotherm

Week 2 : Surface reaction, Rate controlling steps and Rate law, Rate law: Pseudo-steady state hypothesis, Heterogeneous data analysis for reactor design

Week 3 : Design of reactors: PBR and CSTR, Case study: Chemical Vapor Deposition, Catalyst deactivation

Week 4 : Catalyst deactivation: Reactor design, Diffusional effects: Introduction, Internal diffusion effects: Model development, Thiele modulus, Concentration profile

Week 5 : Internal effectiveness factor, Falsification of kinetics, External mass transport limitations

Week 6 : Mass transfer coefficient, Mass transfer to a single particle with reaction. Packed-bed reactor design, Mass transfer coefficient in Packed-beds, Example problems

Week 7 : Overall effectiveness factor, Identification of internal diffusion- and reaction-limited regimes, Packed-bed reactor design, Generalized criterion

Week 8 : Network of first order reactions, Use of experimental data, Packed-bed reactor design with external and internal mass transfer limitations, Fluidized bed reactor design

Week 9 : Fluidized bed reactor design, Fluid-solid non-catalytic reactions

Week 10 : Fluid-solid non-catalytic reactions, Residence time distribution (RTD): Introduction, Non-ideal reactors

Week 11 : Measurement of RTD, RTD function, Properties of RTD function, Reactor diagnostics and troubleshooting

Week 12 : Reactor diagnostics and troubleshooting, Modeling non-ideal reactors, Zero parameter models