Advanced Chemical Reaction Engineering (PG) - Video course

COURSE OUTLINE

Reaction Engineering overview- emerging challenges- ideal reactor design equations- multiple reactions, instantaneous and overall yields.

Energy balance in stirred batch , semi-batch and continuous vessels- energy balance in plug flow vessels - optimal design for exothermic reversible reactions - stability and multiplicity of steady states in CSTR.

Design of packed tubular reactors- Gas solid reactions , shrinking core model, pseudo steady state hypothesis for ash layer control, gas solid reactions in rotary kiln and fluid beds.

Non ideal flow, RTD of ideal vessels, modeling non ideal flow, conversion from RTD theory, tanks in series model, dispersion model -catalyst deactivation, design for deactivating catalysts.

introduction to population balance, application to RTD of CSTR, application to gas solid reactions in Rotary kiln and fluid beds, performance of reactor regenerator system from PBE modeling.

Design for Immobilized cell reactor, design for fermentation alcohol, design for polymerization reactors, biological waste water treatment- flow and reaction through porous media, acid leaching of rocks-liquid liquid reactions-gas liquid reactions , applications in CO2 capture and global warming.

COURSE DETAIL

S.No	Topics
1	a. Overview of Reaction Engineering & challenges. b. Stoichiometric Table & gas law.
2	a. Reactor Design Equations for ideal Vessels. b. Effect of Pressure Drop on Performance of Plug Flow vessels.
3	a. Plug Flow Recycle Reactors design equation , advantages of plug flow recycle reactor. b. Effect of Condensing gas on Reactor design.
4	a. Multiple Reactions, finding number of independent reactions and independent set. b. Polymerization reaction in a CSTR.
5	a. Energy Balance for stirred vessels.

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Chemical Engineering

Pre-requisites:

Chemical kinetics.

Additional Reading:

K.G. Denbigh : Chemical Reactor Theory, Cambridge University Press, Second Edition, 1971.

Coordinators:

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	b. Semi batch reactor operation.
6	a. Stability of Steady States in CSTR. b. Plotting Liapunov Contours. c. Understanding Multiple steady states in a CSTR.
7	a. Heat Effects in reversible exothermic reactions. b. Need for Multi-staging. c. Optimal Design of Reactors for Reversible exothermic reactions.
8	a. One Dimensional & Two dimensional models for PFR. b. Design of Packed Tubular Reactors.
9	a. Gas Solid Non Catalytic Reactions. b. The shrinking Core Model. c. Case of Pseudo steady state hypothesis & ash diffusion control.
10	a. Gas Solid reactions in Rotary Kiln - tracking gas and solid composition changes for reversible reactions. b. Design for Sponge iron reactor.
11	a. Fluid bed reactors. b. Design of fluid bed reactors.
12	a. Catalyst deactivation. b. Design for deactivating catalyst.
13	a. Non ideal Flow. b. Residence Time Distribution of ideal vessels. c. Deriving RTD from velocity field.
14	a. Modeling Non ideal Flow. b. Tanks in series Model. c. Dispersion model. d. Recycle reactor model of non ideal reactors.
15	a. Introduction to population balance modeling. b. Deriving RTD from PBE.
16	a. Deriving particle size distribution for continuous fluid beds via PBE.

	b. Deriving design equations for gas solid reactions via PBE. c. Deriving property distributions in reactor regenerator systems. d. Applications of PBE modeling to real life problems.
17	a. Design equations for Immobilized Enzyme reactors. b. Illustrative examples in Benzyl Penicillin Deacylation.
18	a. Reactors for alcohol fermentation. b. Design Alternatives.
19	a. Reactors for Biological Waste Treatment. b. Design of Biological waste Water Treatment.
20	a. Flow and Reaction through porous media. b. Acid Leaching of Rocks.
21	a. Reaction Engineering for Electronic Devices. b. Illustrative example.
22	a. Gas Liquid Reactions. b. Reaction Regimes.
23	a. Reaction Engineering and mitigation of Global warming. b. CO2 absorption in high pressure water.

References:

1. H. Scot Fogler : Elements of Chemical reaction engineering Prentice Hall , second edition. 1986.
2. J.M. Smith : Chemical Engineering Kinetics, Mcgraw Hill, Third Edition, 1981.
3. O Levenspiel : Chemical Reaction Engineering, Wiley 1997.