

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2004-2005
Course Handout (Part II)

Date: 02/08/2004

In addition to part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. : CHE G541
Course Title : Process Plant Simulation
Instructor-in-Charge : B.V.BABU

Course Description:

Computer aided analysis of chemical process systems; classification and development of mathematical models to various chemical engineering systems; decomposition of networks; tearing algorithms; numerical methods for convergence promotion and solving chemical engineering problems; traditional & non-traditional optimization techniques; specific purpose simulation; dynamic process plant simulation; case study problems using professional software packages.

Scope & Objective:

Process Plant Simulation is a most vital subject of study from the practical point of view of any Process Industry, as unless checked rigorously, errors accumulate throughout the design stages and cause delays in fabrication, erection, and start-up, which affect investment returns adversely. Computer Aided Design and Simulation techniques can help considerably in this regard. There has been a phenomenal growth in the development and sophistication with the advent of digital computers and their ability to handle information. The present course aims at making the student learn the strategies for solving complex plant problems, an approach to simulation and design of any chemical process, and the principles for developing an executive system. It deals with the modeling aspects of various process systems in detail, the modular approaches to process simulation, dynamic simulation and application of numerical methods and optimization techniques.

Text Books:

TB B.V.Babu, "Process Plant Simulation", Oxford University Press, India (2004).

Reference Books:

- R1 Godfrey, C Onwubolu and B.V. Babu, "New Optimization Techniques in Engineering; Springer-Verlag, Germany, (2004).
- R2 William L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", Mc Graw Hill Publishing Company, New York, 2nd Edition (1990).
- R3 R.G.E. Franks, "Modeling and Simulation in Chemical Engineering", John Wiley & Sons Inc., New York (1972).

Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference Chap./Sec. (Book)
1-2	Introduction to Process Synthesis, Analysis, Design and Simulation	Introduction	Ch. 1 (TB)
3-4	Classification of Mathematical Modeling, Similarity Criteria, Variables, Parameters, etc.	Mathematical Modeling	Ch. 2&3 (TB)
5-12	Modeling of various Chemical systems covering heat, mass, and momentum transfer, and reactions.	Chemical Systems Modeling	Ch. 4-7 (TB)
13-15	Sequential and Simultaneous Modular Approaches to be used in process plant simulation	Modular Approaches to Process Simulation	Ch. 11 (TB)
16-20	Partitioning, Decomposition, Disjointing, PTM, SWS-, Steward-, and Rudd-Algorithms, Sparsity, Direct Methods, Pivoting, Iterative methods, BTF, BBTF, Block Back Substitution, BTS, etc.	Equation Solving Approach	Ch. 11 (TB)
21-27	Tearing Algorithms in decomposition of networks, digraph, MCN, signal flow graph, B&M Algorithm, BTA, K&S Algorithm, M&H-1 & -2 Algorithms, and related problems.	Decomposition of Networks	Ch. 12 (TB)
28	Convergence Promotion methods such as Newton's method, Direct substitution, Wegstein's method, Dominant Eigen value method, Quasi-Newton methods, Acceleration criterion, etc.	Convergence Promotion	Ch. 13 (TB)
29	Sources and data banks of physical & thermodynamic properties, Modularity & Routing.	Physical and Thermodynamic Properties	Ch. 13 (TB)
30-35	Importance & applications, limitations, types, methods, direct search routines, Lagrangian multiplier method, Gradient methods (Method of steepest descent & sequential simplex method); Non-traditional optimization techniques such as simulated annealing, genetic algorithms, differential evolution, etc.	Optimization Techniques	Ch. 9 & 10 (TB) & Ch. 2&6 (R1)
36-38	Case studies such as Cascale converter for ammonia production, etc. on specific purpose simulation, and use of professional simulation packages.	Specific Purpose Simulation	Ch. 14 & 15 (TB) & Ch. 9-12 (R1)
39-41	Case studies such as dynamic distillation modeling and simulation, etc. on Dynamic Simulation, and use of professional simulation packages.	Dynamic Simulation	Ch. 14 & 15 (TB) & Ch. 9-12 (R1)

Evaluation Scheme:

EC No.	Component	Duration	Marks	Date & Time	Venue	Nature
1.	Test-I	50 mts.	20			OB
2.	Test-II	50 mts.	20			CB
3.	Compre	3 hrs.	40			CB
4.	Project		20			

Chamber Consultation Hour: To be announced in the class.

Notices: All notices concerning this course will be displayed on the Chemical Engineering & Workshop Notice Boards.

Make-up Policy: Make-up is granted only for genuine cases with valid justification and prior permission of Instructor-in-charge.

**Instructor-in-charge
CHE G541**