

Reservoir Simulation

1.1 Course Number: MA 421

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 4th Year-Even

1.4 Prerequisite: Numerical methods

1.5 Syllabus Committee Member: Dr. C. Kundu (convener), Dr. M.K. Rajpoot, Dr. A Kumar, Dr. G. Rakshit

2. Objective:

Modeling is one of the main methods of knowledge of nature and society. The main objective of the course is to provide the students a basic knowledge of how computer models are used in reservoir engineering to predict the flow of fluids through porous media. Through the simulation they will learn the estimation of field performance (e.g., oil recovery) under one or more producing schemes.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Overview	Purpose of simulation, historical background, modeling vs. simulation, types of simulators (black oil/compositional) and their applications.	5
2	Rocks and Fluid Properties	Physical properties of reservoir rocks, data required for model building, property distributions, initial pressure and saturation distributions, sensitivity of results to data accuracy.	8
3	Reservoir Simulators	Formulation: reservoir simulator equations for single phase, two-phase and three-phase flow using finite difference technique. Method of solution: Approaches- Implicit Pressure & Implicit Saturation (IMPIS) , Implicit Pressure & Explicit Saturation (IMPES), Algorithms- ADIP, Conjugate gradient, generalized Newton-Raphson, direct method, interpolation techniques: least square, Lagrangian interpolation, splines.	15
4	Reservoir Modeling	Models and grid selection criteria, well modeling, aquifer modeling, fault modeling.	6
5	Applications	Reservoir simulation applications, history matching and forecasting.	5
		Total	39

4. Readings

4.1 Textbook:

- *Fundamental of Numerical Reservoir Simulation* by D.W. Peaceman. Elsevier.
- *Fundamentals of Reservoir Engineering* by L.P. Dake. Elsevier.

4.2 Reference books:

- *Principles of Applied Reservoir Simulation* by J.R. Fanchi. Gulf Publishing.
- *Petroleum Reservoir Simulation* by J.H. Abou-Kassem et al. Gulf Publishing.
- *Practical Reservoir Simulation* by M.R. Carlson. Pennwell Pub.

5 Outcome of the Course:

At the end of the course,

- ☞ Students will be able to do derivation of partial differential equations for single phase and multiphase flow in porous materials, and numerical solution methods of these using finite difference methods.
- ☞ Students will understand the process of constructing and running a model whose behavior assumes the appearance of actual reservoir behavior. They will also be able to use common modeling tools for numerical prediction of reservoir behavior