PH 541: SCIENCE AND TECHNOLOGY OF THIN FILMS (4-0-0: 4)

Thermodynamics of Evaporation
Kinetic theory of gases, effusion, Hertz Knudsen equation; mass evaporation rate; Knudsen cell, directional distribution of evaporating species, evaporation of elements, compounds, alloys, Raoult's law.

Physical Vapor Deposition
Thermal, e-beam, pulsed laser and ion beam evaporation, glow discharge and plasma, sputtering - mechanisms and yield, dc and rf sputtering, bias sputtering, magnetically enhanced sputtering systems, reactive sputtering.

Chemical Vapor Deposition
Gas flow system, reaction chemistry and thermodynamics of CVD; thermal CVD, laser & plasma enhanced CVD. Chemical Techniques - spray pyrolysis, electrodeposition, sol-gel and LB techniques.

Nucleation & Growth
Elastic scattering, sticking co-efficient, mechanisim of thin film formation, 2D & 3D growth, rate of nucleation. Epitaxy-homo, hetero and coherent epilayers, lattice misfit and imperfections, epitaxy of compound semiconductors, scope of devices and applications.

Substrate Preparation and Thickness Measurement
Contamination and cleaning process, chemical etching, physical etching, etching induced damage. Thickness measurement by Talystep, quartz crystal microbalance, and optical methods.

Text Books and References:
1. K. S S. Harsha, “Principles of Physical Vapor Deposition of Thin Films”, Elsevier
2. D. L. Smith, “Thin- Film Deposition: Principles and Practices”, McGraw-Hill Education
3. M. L. Hitchman and K. F. Jensen, “Chemical Vapor Deposition: Principles and Applications”, Academic Press
4. D. Kashchiev, “Nucleation: Basic Theory with Applications”, Butterworth-Heinemann
5. H. H. Gatzen, V. Saile and J. Leuthold, “ Micro and Nano Fabrication: Tools and Processes”, Springer