

ME 652 Principles of Heat Transfer in Porous Media(3-0-0-6)

Prerequisites: ME-604: Conduction and Radiation; ME-522: Convective Heat and Mass Transfer

Introduction; Fluid mechanics – Darcy momentum equation; Porosity; Pore structure; Permeability; High Reynolds number flows; Brinkman superposition of bulk and boundary effects; Local volume-averaging method; Homogenization method; Semiheuristic momentum equations; Significance of macroscopic forces; Porous plain media interfacial boundary conditions; Variation of porosity near bounding impermeable surfaces. Conduction heat transfer Local thermal equilibrium; Local volume averaging for periodic structures; Particle concentrations from dilute to point contact; Areal contact between particles caused by compressive force; Statistical analysis: A variational formulation; A thermodynamic analogy. Convection heat transfer – Dispersion in a tube: Hydrodynamic dispersion; Dispersion in porous media; Local volume averaging for periodic structures; Three dimensional periodic structures; Dispersion in disordered structures: Simplified hydrodynamics, particle hydrodynamics; Properties of dispersion tensor; Experimental determination of D; Dispersion adjacent to bounding surfaces. Radiation heat transfer – Continuum treatment; Radiative properties of single particle; Radiative properties: Dependent and Independent; Volume averaging for independent scattering; Experimental determination of radiative properties; Boundary conditions; Solution methods for equation of radiative transfer; Scaling in radiative heat transfer; Noncontinuum treatment: Monte Carlo simulation; Radiant conductivity; Modeling dependent scattering; Recent developments in the analysis of heat transfer in porous media.

Textsbooks/References

- [1] . M. Kaviany, *Principles of Heat Transfer in Porous Media*, Springer-Verlag, New York, 1991.
- [2] R. G. Carbonell and S. Whitaker, *Heat and Mass Transfer in Porous Media*, in Fundamentals of Transport Phenomena in Porous Media, Bear and Corapcioglu, eds., Martinus Nijhoff Publishers. 1984.