TRANSPORT PHENOMENA IN METALLURGY

Module I (12 Hours)

Momentum transfer fundamentals: properties of fluids, types of fluid flow, viscosity of liquid and gases, laminar flow, momentum balance general momentum equation(GME) and its application in flow of falling film, flow through a circular tube, flow between the parallel plates, application of Navier Stokes Equations, turbulent flow: friction factors, flow past submerged bodies, flow through packed bed of solids, fluidized beds, energy balanced application in fluid flow: conservation of energy, flow through valves and fitting, flow from ladles.

Module II (12 Hours)

Energy transport fundamentals: fouriers laws and thermal conductivity of liquids gases, solids and bulk materials, heat transfer and general energy equation and its application in heat transfer with convention and conduction in solids, examples of solidification in sand molds and metal molds, continuous casting, radiation heat transfer, black and grey body radiation, radiations from gases, its application to furnace enclosures and thermal behavior of metallurgical packed bed reactors.

Module III (12 Hours)

Mass transfer fundamentals: molar density of mixture, mole fraction, molar flux, total molar fluxes, diffusion mechanisms in solids, Fick's first law and second law of diffusion, diffusion coefficient and inter diffusion coefficient, mass fraction, mass average velocity, general mass transport equation(GMT), application of (GMT): mass transfer through a near stagnant medium, mass transfer through a near stagnant medium with chemical reaction, examples such vaporization of Zn in molten copper, Silicon growth by chemical vapour deposition, loss of liquid Mn by passes of argon gases. Convective mass transfer: forced convection and natural convection, Navier Stokes Equations, application in mass transfer in laminar film flow, mass transfer in porous solids.

Books for reference:

1. Geiger G.H. and Poirier D.R., Transport phenomena in metallurgy, addison-wesley publishing company.

2. Bird R.B., Stewart W.E.and Lightfoot E.N., Transport phenomena. addison-wesley publishing company.