

# PCMT4205 **Transport Phenomenon**

## **Module I**

**(13 hours)**

Momentum transfer (fluid flow): Physical Properties of Fluid, Fluid static, Newtonian and non-Newtonian fluids, factors affecting viscosity, estimation of viscosity of gases, gas mixtures, liquid metals and slags; equations of fluid flow and their metallurgical applications, overall energy balance approach for turbulent flow, friction factor; flow through packed and fluidized beds, interaction of gas jets and liquid metals; theory of similarity, dimensional analysis.

## **Module II**

**(12 hours)**

Heat transfer: Factors affecting thermal conductivity of gases, liquids, solid metals and alloys and composites; equations and correlations of convective heat transfer and their metallurgical applications, laws of radiative heat transfer, view factor, radiative heat exchange in furnaces containing transparent and absorbing media; conductive heat transfer in solid materials under steady state and unsteady state conditions, heat transfer with change of state (melting/solidification).

## **Module III**

**(15 hours)**

Mass transfer: Mass transfer by diffusion, factors affecting diffusivity in solid and liquid metals and gases, diffusion through porous materials; general equation of mass transfer with diffusion, convection and chemical reaction, mass transfer co-efficient and its models, mass transfer correlations and their applications; gas-solid reaction.

Application of transport phenomena in modeling and simulation: theory of similarity and dimensional analysis, case studies; some case studies of mathematical modeling in metallurgical systems – gas stirred ladle, continuous casting etc...

### **Books for Reference:-**

1. Transport Phenomena by R. B. Bird, W. E. Stewart and E. N. Lightfoot, Wiley, 1960
2. Transport Phenomena in Metallurgy by G. H. Geiger and D. R. Poirier, Addison-Wesley, 1973.
3. Rate Phenomena in Process Metallurgy by J. Szekely and N. J. Themelis
4. Rate Processes in Metallurgy by A. K. Mohanty, PHI