

**Instructor Name :****SOMNATH BHATTACHARYYA & GP RAJA SEKHAR (IIT Kharagpur - Mathematics)****PROF. G P RAJA SEKHAR (IIT Kharagpur - Mathematics)****COURSE DURATION :** Feb-Apr 2017 **CORE / ELECTIVE :** Elective **UG / PG:** Both**PRE-REQUISITES :** Partial differential equations, Basic Fluid Mechanics, Numerical Methods.**INTENDED AUDIENCE :** Chemical, Mechanical, Aerospace, Biotech., Mathematics, Physics**INDUSTRIES APPLICABLE TO :** ISRO; NAL; DRDO; CSIR- Institute of Minerals and Materials Technology, Bhubaneswar ; CSIR-CSMCRI, Bhavnagar (Gujarat)

COURSE OUTLINE : The aim of this course is to introduce the transport phenomena of microparticles like viscous drops, microorganisms, rigid colloids, soft particles involve in micro- and nano-fluidics. The course provides basic understanding of particular solutions of Navier-Stokes equations, application of Stokes stream function, introduction to governing equations of porous media and electro-hydrodynamics. Subsequently, glimpses of important applications like migration of viscous drops under external gradients, active motion of particles that model swimming microorganisms will be provided. Electrically driven flow in micro- and nano-scale will be introduced. Motion of charged colloids, soft particles mimicking bacteria, humic substances, under electric field in electrolyte or gel medium will be modelled. Numerical techniques to solve the equations governing the advection-diffusion transport will be introduced. The course will be supplemented with assignments on simpler problems related to transport phenomena.

ABOUT INSTRUCTOR : Prof. S. Bhattacharyya, Professor of Mathematics in HAG scale at IIT Kharagpur, working in the area of Computational Fluid Dynamics and Microfluidics Modelling. He has published more than eightyfive research papers in highly reputed international journals. He has completed several research projects sponsored by the DST, SERB and CSIR and has received several awards and fellowships for research collaboration in USA, UK and Germany, which includes the BOYSCAST, DST fellowship, EPSRC, UK fellowship, Max-Planck fellowship, Germany, DARPA, USA etc.

Prof. G P Raja Sekhar is a Professor of Mathematics at IIT Kharagpur working in the area of Viscous flows and flow through porous media. He has published more than 50 publications in reputed international journals. He has completed several research projects sponsored by DST, CSIR. He has received INSA Young Scientist Medal, INSA-Royal Society fellowship, JSPS Post Doctoral Fellowship and Alexander von Humboldt Fellowship for Experienced Researchers. He has contributed one NPTEL video course on Numerical Solutions of ODE and PDE.

COURSE PLAN**Week 1:**Basics of transport phenomena, Navier-Stokes equations**Week 2:**Stokes Flow and applications**Week 3:**Hydrodynamic phenomena of droplets**Week 4:**Flow through porous media, Darcy equation, Brinkman equation**Week 5:**Electrokinetic Transport , Nernst-Planck equations, Debye-Huckel Approximation**Week 6:**Electroosmosis, Debye layer overlap**Week 7:**Numerical Methods for BVPs and PDEs**Week 8:**Electrophoresis of colloids, Double layer polarization, Gel electrophoresis