INTERFACIAL FLUID MECHANICS

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PRE-REQUISITES : Students should have completed a basic course (UG or PG level) in fluid mechanics and should be comfortable with multivariable calculus

INTENDED AUDIENCE : Students in Chemical Engineering, Mechanical Engineering and Engineering Physics; Industry personnel working in the broad area of multiphase flows.

INDUSTRY SUPPORT : Industries specifically focusing on problems studied by Chemical Engineers such as problems involving two-phase flows, interfaces with surfactants, wettability of surfaces, etc. Example industries include Whirpool Corporation, Saint Gobain, Unilever, etc.

COURSE OUTLINE :

This course will introduce the student to the wonderful and beautiful world of interfacial fluid dynamics. These are fluid systems dominated by surface or interfacial tension. First half of the course will deal with many examples of fluid systems dominated by surface tension followed by a detailed discussion of the relevant governing equations and boundary conditions. Static systems – shape of a meniscus, shape of a drop, etc will also be discussed. Second half of the course will focus on specific fluid systems, viz. thin films, shape of a falling jet, coating flows, well-known instabilities like the Rayleigh-Taylor and Rayleigh-Plateau instabilities, Marangoni effects, contact lines, etc. Throughout the course, theoretical concepts will be related to real-world examples.

ABOUT INSTRUCTOR :

Prof. Harish N Dixit is an Associate Professor at the Mechancial & Aerospace Engineering department at IIT Hyderabad. He completed his Ph.D. at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bengaluru and was subsequently a postdoctoral fellow at the University of British Columbia in Canada. He has been a faculty at IIT Hyderabad since October 2013. He works in the broad area of interfacial flows with specific focus on problems related to interaction of drop and bubbles with interfaces as well as the dynamics of a moving contact lines. His group employs a combination of theoretical, experimental and numerical tools to unravel novel physics in interfacial flows.

COURSE PLAN :

Week 1: Introduction to interfacial systems
Week 2: Governing equations and boundary conditions
Week 3: Capillary statics: part-1
Week 4: Capillary statics: part-2
Week 5: Capillary statics: part-3
Week 6: Capillary rise – dynamics of impregnation.
Week 7: Dynamics of a thin film
Week 8: Coating flows, sheets and jets
Week 9: Instabilities
Week 10: Marangoni effects
Week 11: Hydrodynamics of a moving contact line
Week 12: Advanced topics in interfacial systems