



Project Proposal for Ph.D.

Project Details	
Project Title	Anisotropic electrostatic screening and morphological transitions in biological cells
Project Summary (Minimum 500 and maximum 2000 characters)	Cellular events take place on various length and time scales. Such events involve endocytosis/exocytosis during cellular transport, protein binding mediated membrane tubulation, filopodia during cell migration, budding transition in response to osmotic swelling/membrane charge, etc. All of these and many other cellular events are governed by morphological changes in the shape of bilayer membrane of biological cells. In the last few decades, charge-membrane coupling has gained particular attention because the membrane of most cell types has a slight negative charge due to the presence of charged lipids, charged proteins, ion-channels, etc. Despite extensive studies on charge-membrane curvature coupling, renormalization of membrane bending modulus due to surface charge, charge-induced shape change; an understanding of anisotropic electrostatic screening in bilayer membrane seems to be lacking. Thus, the proposed study will provide an opportunity to understand the role of charged membrane surfaces in various cellular events. This study will have implications in the estimation of mechanical properties of biological cells. The project will involve an in-depth study of the anisotropic electrostatic screening mechanism and its coupling with anisotropic elasticity and curvature of the membrane using mathematical models and computational techniques. For the execution of the problem, concepts of hydrodynamics, electrostatics, cell mechanics, and biophysics will be required.

Ph.D. Supervisors				
Role	Name of Faculty		Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Nikhil Walani		Applied mechanics, IIT Delhi	nwalani@iitd.ac.in
Supervisor 2	Priti Sinha		Department of Biochemical Engg. and Biotechnology, IIT Delhi	sinhapriti@iitd.ac.in

Project requirements (Student qualifications, experience required, etc) *The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)
- Students with background in Mechanical engineering/Chemical engineering/Applied mechanics/Physics - Computational skill: Knowledge of MATLAB, FORTRAN, MATHEMATICA (Not mandatory)

Source of fellowship/funding (CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)
Institute Fellowship/ Project Fellowship

Role of Faculty Members involved:	
Supervisor-1	Anisotropy study and phase field simulation
Supervisor-2	Theoretical model development for membrane electrodynamics