Name of Proposer:	Murali Damodaran
Email	murali@iitgn.ac.in
Proposed Areas of research for PhD candidates:	NUMERICAL STUDIES ON PLASMA ACTUATORS FOR AERODYNAMIC DRAG REDUCTION Recently there has been an enormous interest is the application of plasma actuators for aerodynamic drag reduction through magneto-aerodynamic interaction which has implications for reduction in fuel costs. There exists some excellent experimental work in this area demonstrating proof-of concept models for this technology. The magneto-aerodynamic interaction induced by surface plasma can be modeled by gas glow discharge and dielectric barrier discharge (DBD) which is the most widely adopted plasma actuators. Extensive research in DBD has shown that this plasma actuator has the ability to delay separation on both airfoils and turbine blades, induce flow in stationary air and add momentum to induced flow. The addition of momentum to induced flow has implications for boundary layer control on aerodynamic surfaces. As this area is rich in basic fluid dynamics studies, ample problems in this area such as attenuation of shock waves by plasma and so on at high speeds can be researched using numerical and experimental methods. Proposed activities will focus on the development and application of numerical models to study of the magneto-aerodynamic effect using coupled compressible flow equations and Maxwell's electro-magnetic field equations. The possibility of developing experimental activities through a partnership with the Institute of Plasma Research at Gandhinagar and National Aerospace Laboratory, Bangalore is being firmed up at this moment.
Required qualification of applicants	• Expected to have at least a Master's Degree (MTech, MEng) in Mechanical/Aerospace Engineering from a good university (IIT/IISc), good GATE score, has a curious mind and a willingness to work very hard and have fun at exploring new avenues in computational science and engineering. • Familiarity with Linux Operating System, Parallel Programming, C/C++, Python, Matlab, Computing on Multi-Core Computing Platforms and a general interest in developing modern computational skill sets are desirable. Have a keen interest in Mathematical and Computational Modeling using High Performance Computing Platforms • Interest and Domain knowledge in Fluid Mechanics, Structural Dynamics, Multiple Degrees of Freedom Dynamics, Applied Mathematics, Computational Methods, Deterministic and Stochastic Optimisation methods.

Name of Proposer:	Murali Damodaran
Email	murali@iitgn.ac.in
Proposed Areas of research for PhD candidates:	COMPUTATIONAL STUDY OF UNSTEADY AERODYNAMICS OF A PARAFOIL A parafoil is a flexible body inflated by ram air as a result of relative motion. The cross section of a parafoil resembles an airfoil with the rounded front chopped off to form the vent which enable it to be inflated via ram air. This causes drag, which can be reduced by restoring the rounded front, into which are then sewn patches of gauze or mesh to form the inlets. The upper and lower panels are often made from a single piece of fabric wrapped over the internal ribs. The aim here is to study of the evolving dynamics of the unsteady interaction between the parafoil and the ambient airflow. Incompressible and compressible flow solvers on overlapping grids based on the open source fluid dynamics software based on Composite Grid Technology (CGINS and CGCNS of LLNL, US) have

	been used to study the dynamics of rigid and flexible flapping wings. A structural dynamics module has been written up and added to the software suite to address the interaction between flexible deforming bodies and ambient fluid and the coupled set of fluid dynamics and structural dynamics equations are solved using an implicit partitioned algorithm. The effect of spatial and temporal accuracy of the discretized structural dynamics equation on computed solutions has been analyzed. It has also been shown that a proper combination of time step, numerical relaxation and damping yields stable numerical solutions. By treating each deformed shape as a rigid body at a given time instant, the position of the body is computed based on the aerodynamic forces for different flexibilities. The aim of this project is to develop a high fidelity unsteady aerodynamics module to provide estimates of unsteady aerodynamic force and moment coefficients which can be coupled to the flight dynamics of parafoil applications for airdrop of military logistics and relief supplies which are being pursued at the Dept. of Aerospace Engineering at IIT-Kanpur.
Required qualification of applicants	"• Expected to have at least a Master's Degree (MTech, MEng) in Mechanical/Aerospace Engineering from a good university (IIT/IISc), good GATE score, has a curious mind and a willingness to work very hard and have fun at exploring new avenues in computational science and engineering. • Familiarity with Linux Operating System, Parallel Programming, C/C++, Python, Matlab, Computing on Multi-Core Computing Platforms and a general interest in developing modern computational skill sets are desirable. Have a keen interest in Mathematical and Computational Modeling using High Performance Computing Platforms • Interest and Domain knowledge in Fluid Mechanics, Structural Dynamics, Multiple Degrees of Freedom Dynamics, Applied Mathematics, Computational Methods, Deterministic and Stochastic Optimisation methods.

Name of Proposer:	Murali Damodaran
Email	murali@iitgn.ac.in
Proposed Areas of research for PhD candidates:	A three-dimensional hybrid continuum-DSMC (Direct Simulation Monte-Carlo) model based on the Schwarz Alternating Method has been developed to couple domains dominated by rarified flow which is modeled by the DSMC method to the continuum flow outside such domains which are modeled by Navier-Stokes equations. The hybrid coupling is done using overlapped regions and the Chapman-Enskog molecular velocity distribution is used to impose boundary conditions from the atomistic region to the continuum region. Such a flow model has been used to predict the flow field in the vicinity of a head-disk interface (HDI) gap between a slider and the disk of a hard disk drive. Preliminary modeling of particle-laden flow using a two-phase model based on computed forces acting on a particle under rarefied gas flow conditions has also been incorporated in a parallel three dimensional DSMC method to compute particle trajectories in the HDI gap. This project aims to enhance the incorporation of the multi-phase DSMC, address the computational issues and to couple the hybrid flow model with a 6-DOF dynamics model to address the computation of unsteady flows in the HDI gap as a result of the motion of the arm carrying the swiveling slider carrying the read-write head relative to the spinning disk.
Required qualification of applicants	• Expected to have at least a Master's Degree (MTech, MEng) in Mechanical/Aerospace Engineering from a good university (IIT/IISc), good GATE score, has a curious mind and a willingness to work very hard and have fun at exploring new avenues in computational science and engineering.

	• Familiarity with Linux Operating System, Parallel Programming, C/C++, Python, Matlab, Computing on Multi-Core Computing Platforms and a general interest in developing modern computational skill sets are desirable. Have a keen interest in Mathematical and Computational Modeling using High Performance Computing Platforms • Interest and Domain knowledge in Fluid Mechanics, Structural Dynamics, Multiple Degrees of Freedom Dynamics, Applied Mathematics, Computational Methods, Deterministic and Stochastic Optimisation methods.

Name of Proposer:	Vinod Narayanan
Email	vinod@iitgn.ac.in
Proposed Areas of research for PhD candidates:	Identifying the flow regimes in spherical Couette flow. This work is intend to study the flow patterns in flow between two concentric rotating spheres. The characteristic features of the flow to determine the the particular scenario of transition.
Required qualification of applicants	M-Tech or equivalent degree in Mechanical, Aerospace or Chemical Engineering with strong background in Fluid Dynamics, Mathematics and numerical methods.