

Name of Proposer:	N. Kishore Kumar
Email	narapara@iitgn.ac.in
Proposed Areas of research for PhD candidates:	<p>Title: Nonconforming spectral element methods for elliptic interface problems</p> <p>Introduction:</p> <p>In the solution of the elliptic boundary value problems singularities may occur, when the boundary is not smooth or the boundary is smooth yet one or more of the given data of the problem are not smooth. The later type of singularity typically arises in interface problems. The solution of the interface problem for the elliptic partial differential equation has interface singularity at the points which are either the intersection of interfaces or the intersection of interfaces with the boundary of the domain. For these interface problems the solution will also have singular behavior at the points where the interfaces crosses each other. These singularities are very similar to the singularities which generally arises in elliptic problems on non smooth domains. But the strength of the singularities are very strong. The hp- finite element method gives exponential accuracy for these problems.</p> <p>When the interface is smooth enough the solution of the interface problem is also very smooth in the individual regions but the global regularity is low. Due to lack of the global regularity many standard finite difference algorithms do not apply for interface problems. The accuracy of many other numerical methods (like standard finite element method, Immersed interface methods, et. al. ) is controlled by the order of approximation of the interface. Only lower order elements have been studied so far in the literature.</p> <p>Research Proposal:</p> <p>An exponentially accurate nonconforming spectral element method has been proposed by us in the case of smooth interface. The PhD candidate is expected to work on the following problems.</p> <ul style="list-style-type: none"> <li>- To extend the method to elasticity interface problems (which generally occurs in material science like the microstructural evolution of precipitates in an elastic matrix due to the diffusion of concentration, morphological instability instability due to stress-driven surface diffusion in solid thin films, etc. ).</li> <li>- To extend the method to the non smooth case.</li> </ul> <p>Required Background:</p> <p>Elliptic partial differential equations, hp/spectral element methods, Domain Decomposition methods, Iterative solvers, Parallel computing.</p>
Required qualification of applicants	M.Sc Mathematics with CSIR/GATE or M.Tech Civil/Mechanical Engineering who are interested in structural mechanics problems.

Name of Proposer:	Jagmohan Tyagi
Email	jtyagi@iitgn.ac.in
Proposed Areas of research for PhD candidates:	Ordinary Differential Equations(ODEs): Existence of solutions of different kind of ODEs, Qualitative behavior of the solutions, like, Sturm type comparison theorems, oscillation-non-oscillation criteria.  Elliptic Partial Differential Equations (EPDEs): Existence of solutions of semilinear/quasilinear EPDEs, Qualitative behavior of the solutions, Comparison theorems, Stability analysis.
Required qualification of applicants	M.Sc. in Mathematics with valid GATE score/CSIR fellowship.