Department of Computational and Data Sciences (CDS)
Indian Institute of Science, Bangalore
Computational Science (CDS-CP)
M.Tech (Research) and PhD Admissions 2016

This brochure provides information on the Research (M.Tech by research and PhD) admission process into CDS-CP. It describes the research laboratories in the CDS-CP stream which are accepting students this year, and the topics for the written and oral components of the research interview. A ***Preference Sheet*** appended at the end of this brochure must be filled and signed by you when you appear for the interview.

A. Research Activities at CDS

Research activities at CDS are categorized into two streams: *Computational Science* and Computer systems. Research admissions are conducted *separately* for each stream, so please refer the appropriate brochure.

B. Research Interview– Computational Science Stream (CDS-CP)

The interview process for the Computational Science stream has two stages: **Written and Oral** (**both conducted on the same day**).

1. **Written component** *(Duration: 30 minutes):* Total Points 5X2=10
   (a) Two mandatory questions, one from polynomials, functions, plotting, etc and another is a programing question
   (b) Answer any three out of five questions asked from the following subjects: Elements of Engineering Mathematics: Linear Algebra/Matrix Analysis, Probability and Statistics, Differential Equations and Numerical Methods.

2. **Oral Interview**: Candidates who are successful in the written component will attend an oral interview before a CDS-CP faculty committee. In the oral interview, you will be questioned on:
   - ***Basic Area Subjects:*** Programming fundamentals; Linear Algebra; Numerical Methods; and Probability & Statistics. Final year engineering undergraduate level preparation is required.
   - ***Advanced Topics:*** Matrix Algebra, Numerical and Functional Analysis, Numerical Solution of ODEs and DAEs, Finite element methods, Signal processing, Stochastic Calculus, Computational Biology and Structural Bioinformatics, Graph Algorithms, Structural Biology and Bioinformatics

C. List of labs that accept students

1. **Stable, Accurate, Fast, Robust Algorithms & Numerics Lab** faculty: Sivaram; cds.iisc.ac.in/faculty/sivaram/

   The group works on theoretical & computational aspects of numerical analysis & linear algebra algorithms with a focus on constructing highly accurate fast stable algorithms for electromagnetics, elasticity, fluid mechanics, computational statistics, inverse problems and filtering. The overarching goal of the group is to develop robust algorithms founded in rigorous mathematics and convert them into technologies, which in-turn will be used as black-box tools for the aforementioned applications.

2. **Computational & Statistical Physics :** faculty: Murugesan; cds.iisc.ac.in/faculty/murugesh/

   A part of this group studies light-matter interactions and other properties of materials using numerical models. Another part works on matrix algebra and developing computational formulations for physics.

3. **Biomolecular Computation Laboratory:** faculty: Debnath Pal; pallab.serc.iisc.ernet.in/lab.php

   The focus of Biomolecular Computation Lab is to understand biological function at multiple scales. Towards this goal we work at molecular level and pathway level and develop methods and algorithms to understand biochemical function better. The scope of work spans the areas of genomics, proteomics and metabolomics. We also work on biomolecules to understand sequence, structure function relationships, their interactions and dynamics. There is opportunity to do research problems in real-life projects in cancer, diabetes, neurodegeneration etc., where intensive bio-computational analysis is required.

4. **Structural Biology & Bio-Computing:** faculty : Sekar physics.iisc.ernet.in/~dichome/sekhome/index.html

   The research group focuses on solving three-dimensional crystal structures of protein molecules using X-ray crystallography and molecular dynamics simulations. Further, we are also interested in data mining of protein sequences and structures.

5. **Medical Imaging Group:** faculty: Phaneendra; cds.iisc.ac.in/faculty/phani/

   The Medical Imaging Group (MIG) focuses on developing novel computational methods in medical imaging. The group works on Medical Image Reconstruction, High Performance Computing in Medical Image Processing, Biomedical Optical Image Reconstruction (Diffuse Optical Tomography and Photoacoustic Tomography), Neuroimaging (fMRI analysis and atlas/template creation), and Biomedical Signal Processing.

6. **Scientific Computation Lab:** faculty: Raha;
   cds.iisc.ac.in/faculty/raha/

   Current research interest is in computational methods for simulation, optimization and control of constrained and stochastic dynamical systems, and application to problems in Mechanics and Biochemical Kinetics. There is also an interest in co-design of numerical algorithm and architectural elements of accelerators toward efficient and high performance implementation of the computational methods for dynamical systems.

7. **Computational Mathematics Group:** faculty: Sashikumaar
   cds.iisc.ac.in/faculty/sashi/

   The research group focuses on the development and advancement of robust numerical (finite element) methods and solver for solving partial differential equations (PDEs) that describe incompressible fluid flows and species concentration and/or energy in complex systems. The group also works on implementing efficient parallel algorithms for high-performance computing.

Preference Sheet for Research Admissions

Computational Science Stream (CDS-CP)

Carefully review the brochure and Research Lab/Group descriptions before filling this Preference Sheet. Choose the lab(s)/Group(s) whose research areas match your own interest. You may choose up to three labs/Group(s) Ph.D. students, if admitted, will be placed in the lab(s)/Group(s) chosen here, and this selection is binding.

1. Name: _____
2. Application No: _____
3. Program: *(Tick one)* [ ] M.Tech. (research) [ ] Direct Ph.D. [ ] Ph.D.
4. External Research Program Candidate? *(Tick one)* [ ] No [ ] Yes
5. Select up to three Research Labs below, and indicate your 1st, 2nd and 3rd choice, if you select more than one.

[ ] Stable, Accurate, Fast, Robust Algorithms & Numerics Lab (Sivaram)

[ ] Computational & Statistical Physics (Murugesan)

[ ] Biomolecular Computation Lab (Debnath Pal)

[ ] Structural Biology & Bio-Computing Lab (Sekar)

[ ] Medical Imaging Group (Phaneendra)

[ ] Scientific Computation Lab (Raha)

[ ] Computational Mathematics Group (Sashikumaar)

I have read and understood the brochure and the instructions before filling in this Preference Sheet.

Signature: _____

Date: _____

Place: _____