Research activities at CDS are categorized into two streams: Computational Science (CD-CP) and Computer and Data systems (CD-CS). The candidate has to apply for CDS and the department committee will shortlist the candidates for research interview based on GATE Score and/or B.Tech./M.Tech. scores. The shortlisted candidates will have to attend an interview which consists of written component and oral interview. Candidates have to carefully review their eligibility and choose one stream, either CD-CP (Computational Science) or CD-CS (Computer and Data System) at the time of interview. The written component will differ between these streams, please refer to the appropriate brochure carefully before filing in the combined preference sheet.
Department of Computational and Data Sciences (CDS)
Indian Institute of Science, Bangalore

**Admissions Brochure for Computational Science (CD-CP)**

**PhD and M.Tech (Res), Aug 2019 Cycle**

This brochure provides information on the Research Admission process into the Computational Science Stream (CDS-CP) of CDS for 2019. 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 combined Preference Sheet appended at the end of this brochure must be filled and signed by you when you appear for the interview.

**A. Research Streams at CDS**

Research activities at CDS are categorized into two streams: **Computational Science (CDS-CP)** and **Computer and Data systems (CDS-CS)**. Research admissions are conducted separately for each stream, so please refer the appropriate brochure. **This brochure is only for Computational Science.**

**B. Research Admission Process – Computational Science Stream (CD-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 $5 \times 2 = 10$
   (a) Two mandatory questions: one will be from polynomials, functions, plotting, etc and another will be a programming question
   (b) Answer any three out of four questions asked from basic engineering mathematics on following topics: Linear Algebra/Matrices, Probability and Statistics, and Differential Equations.

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 the basic subjects, and based on your choice of an advanced topic and lab preferences:

   **Basic Area Subjects**: Programming fundamentals; Linear Algebra; Numerical Methods; Ordinary Differential Equations; Probability & Statistics. Final year undergraduate level preparation is required.

   **Advanced Topics**: Matrix Algebra, Numerical and Functional Analysis, Numerical Solution of Differential and Differential-Algebraic Equations, Finite Element Methods, Signal Processing, Computational Biology and Structural Bioinformatics, Graph Algorithms, Structural Biology and Bioinformatics, Computational Fluid Dynamics.
C. List of labs that accept students

1. Medical Imaging Group (MIG)

Faculty: Phaneendra Yalavarthy; http://cds.iisc.ac.in/faculty/yalavarthy/MIG/

The research group works on developing computational methods/models in medical imaging. The recent focus has been toward deep learning methods for medical image reconstruction and analysis. Significant portion of the research work in the lab is dedicated toward clinically relevant work with an emphasis on fast imaging methods.

Accepting Ph.D and M.Tech (Res)

2. 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 bio-molecules 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.

Accepting only Ph.D

3. Structural Biology & Bio-Computing Lab

Faculty: K. 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.

Accepting Ph.D and M.Tech (Res)

4. Computational Mathematics Group

Faculty: Sashikumaar Ganesan; http://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.

Accepting only Ph.D
5. Computational & Statistical Physics Lab

Faculty: Murugesan Venkatapathi; http://cds.iisc.ac.in/faculty/murugesh/

This group is suited for students interested in physics, or mathematical analysis, or scientific algorithms. Examples of our recent results include a theory of strong-coupling of emitters with dissipating matter, computational method for quantum N-body problems in emission, analysis of polynomial recurrence relations and fast computing methods for eigenvalue problems, methods of estimation to substitute Markov-Chain-Monte-Carlo (MCMC) sampling, and error estimators for linear solvers.

Accepting Ph.D and M.Tech (Res)

6. QUEST (Quantifying Uncertainty in Engineering, Science and Technology) Lab

Faculty: Deepak Subramani; http://cds.iisc.ac.in/faculty/deepakns/

The goal of our research is to build holistic science-based data-driven computational solutions to complex engineering and environmental problems. Example applications include climate change, cyclone predictions, coastal hazard management, and optimal vehicle routing. Pursuant to our goal, we develop and apply fundamental theories, numerical schemes and software systems. We invite students who are interested in any of the following topics: numerical solution of stochastic partial differential equations, uncertainty quantification, Bayesian and deep learning of dynamical systems, fluid dynamics of the atmosphere and oceans, and path planning of autonomous vehicles in dynamic environments.

Accepting Ph.D and M.Tech (Res)

7. Computational Flow Physics Lab

Faculty: Konduri Aditya; https://akonduri.github.io

The research group focuses on the simulation and analysis of multi-scale multi-physics fluid flow problems that leverage high performance computing (HPC) platforms. Specifically, the work would involve development of HPC centric numerical methods and algorithms for solving partial differential equations, application of machine learning methods to analyze and model data generated from simulations, and investigation of turbulent flow problems that arise in combustion systems, high-speed aerodynamics and environmental flows.

Accepting Ph.D and M.Tech (Res)

8. Computer Aided Design Laboratory (CADL)

Faculty: S. K. Nandy; http://cadl.iisc.ernet.in/cadlab/

Many-core System-on-Chip (SoC) architectures, Compiling for many-core architectures, Runtime reconfigurable architectures for accelerated computing in applications spanning Machine Learning, Bio-informatics, Modeling and Simulations, media streaming, IoT, and network processing. Accepting Ph.D and M.Tech (Res)

Students may only attend either CD-CP or CD-CS interview. These will be held separately in the CDS building.

Eligibility for CD-CP: BE / B Tech or equivalent degree in any discipline or M Sc or equivalent degree in Mathematical Sciences; Physical Sciences; Electronics; Instrumentation; Computer Science or Master’s in Computer Application. In all cases: a background in Mathematics and Programming is required

Eligibility for CD-CS: BE / B Tech or equivalent degree in Computer Science/Engineering; Information Technology/Science; Electrical and Communication Engineering; Electrical Engineering or Master’s degree in Computer Science; Computer Application or Electronics. In all cases: a background in Programming is required

Carefully review the Brochures, and Research Lab descriptions and websites before filling in this Preference Sheet. You may choose only a single stream, and up to three labs in that stream. Choose the lab(s) whose research areas most closely match your own interests. Ph.D. students, if admitted, will be placed in the lab(s) chosen here and this selection is binding.

1. Research Stream (Tick Only One): [ ] CD-CP [ ] CD-CS

2. Name: ____________________________________________________________

3. Application No: ____________________________________________________

4. Program (Select all that apply): [ ] Direct Ph.D. [ ] Ph.D. [ ] M.Tech. (Res)

5. External Research Program Candidate? (Tick one) [ ] No [ ] Yes

6. Rank up to three Research Labs in your selected stream using numbers 1, 2 and 3.

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I have read and understood the brochure and the instructions before filling in this preference sheet.

Signature: ____________________ Date: ______________ Place: ______________