



IIT KANPUR

Indian Institute of Technology Kanpur

DEPARTMENT OF INTELLIGENT SYSTEMS

**Doctor of Philosophy (Ph.D.)
Program**

AY 2025 - 26

Website
<https://iitk.ac.in/dis/>

OBJECTIVE

The Department of Intelligent Systems is actively engaged in cutting-edge research across all current areas related to intelligent systems such as machine learning, data science, natural language processing, computer vision, cyber-physical systems, robotics, and related fields. The focus of our PhD program is on intensive research training with a high level of specialization. The objective of this training is to equip our PhD students with deep expertise in their respective areas, enabling them to pursue careers in academia, research, or industry in the rapidly evolving field of intelligent systems.



BROAD RESEARCH AREAS

Cyber-Physical Systems

Faculty Members: Indranil Saha

The CPS Group at the Department of Intelligent Systems at IIT Kanpur is committed to developing systematic approaches for the robust design and implementation of cyber-physical systems. These systems consist of interconnected computing devices that interact with the physical world to regulate its behavior. The group's research focuses on ensuring system correctness by utilizing advanced formal verification and synthesis techniques. They tackle a variety of complex challenges, particularly in the fields of autonomous vehicles, warehouse management, disaster response, and precision agriculture.

Robotics

Faculty Members: Shakti S. Gupta, Ketan Rajawat, Indranil Saha

At the Department of Intelligent Systems at IIT Kanpur, robotics research is centered on developing advanced autonomous systems with a focus on perception, planning, and control. The group is working on scalable algorithms for multi-robot coordination, including task allocation and collision-free navigation in complex, dynamic environments. We leverage reinforcement learning to enable robots to adapt to uncertainties and optimize their behaviors in real-time. A key area involves integrating sensors and communication networks to enhance perception and decision-making in distributed multi-UAV systems. Another major focus of the research is designing and improving quadruped robots, including motion planning, gait generation, and limb synchronization to achieve natural, complex movements. These efforts aim to create intelligent, resilient, and adaptable robotic systems capable of reliable operation in real-world scenarios.

Optimization

Faculty Members: Ketan Rajawat

Our research focuses on optimization algorithms with applications spanning machine learning, signal processing, and networked control systems. We develop advanced stochastic, distributed, and nonconvex optimization methods with provable convergence guarantees. These algorithms are applied to real-world problems in autonomous systems, including trajectory optimization, decentralized control, and communication-efficient coordination of multi-UAV networks.

Machine Learning

Faculty Members: Piyush Rai and Rohit Budhiraja

Department focuses on developing principled models and algorithms for learning from complex, high-dimensional data. The research emphasizes probabilistic generative modeling and the design of efficient optimization and inference algorithms to uncover compact, interpretable latent structures and feature representations. These models enable better understanding, summarization, and controlled generation of data, while also improving predictive performance under uncertainty. A significant thrust of the group's work involves designing learning algorithms suitable for resource-constrained environments, such as limited training data or computational resources. The overarching goal is to build robust and interpretable machine learning systems capable of making reliable decisions in uncertain and dynamic real-world scenarios.

Human-AI Interaction

Faculty Member: Nisheeth Srivastava

Focuses on the intersection of computational cognitive science and human factors in computing. The research focuses on understanding how humans interact with intelligent systems and designing AI technologies that are intuitive, adaptive, and aligned with human cognition and behavior.

Software Engineering

Faculty Member: Amey Karkare

The Software Engineering group at the Department of Intelligent Systems at IIT Kanpur focuses on developing AI-driven educational technologies that enhance learning effectiveness and accessibility. The research explores personalized learning systems, automated tutoring using natural language processing, and blockchain-based credentialing for secure academic records. The group also works on improving the scalability and interoperability of these systems, ensuring seamless integration with diverse educational infrastructures and multi-language support for a global learner base.

Control

Faculty Member: Soumya Ranjan Sahoo

Research focuses on control theory and combining the same with machine learning to enable autonomous systems like unmanned vehicles and robot manipulators to operate in uncertain and dynamic environments. We develop linear and nonlinear controllers for such systems, analytically establish stability and performance of systems under these controllers, and validate our methods through implementation on experimental prototypes.

Cybersecurity

Faculty Member: Manindra Agrawal, Somitra Sanadhya and Nitin Saxena

Focuses on advancing research in **reverse engineering and malware analysis**, and **analysis of operational technology (OT) protocols** such as Modbus and DNP3. The group works on the **design of secure QR codes**, **security of AI systems**, and the **use of AI techniques to develop stronger defensive mechanisms**. Research also includes the **design and cryptanalysis of symmetric cryptographic systems** and the **development and implementation of post-quantum cryptographic algorithms**, aiming to build robust and future-ready security frameworks.

Pervasive and Mobile Computing

Faculty Member: Rohit Budhiraja

The Pervasive and Mobile Computing group at the Department of Intelligent Systems at IIT Kanpur conducts research across the core pillars of 5G and 6G wireless systems—theory, standardization, and system prototyping. The group develops scalable solutions using optimization, signal processing, and AI/ML for next-generation communication networks. Alongside theoretical research, the team actively contributes to global standardization efforts and builds real-world testbeds spanning 3G to 6G technologies, bridging the gap between concept and deployment.

ADVISING

Each PhD student is advised by a faculty member from the department. In some exceptional cases, a student may have a secondary advisor together with the primary advisor. At the time of admission, a newly admitted PhD student will be provided with one or more options for the PhD advisor. These are the faculty members who show interest in mentoring the student in her PhD research work. The student has to choose one of them as her primary advisor before registering with the PhD program. Upon the advice of the primary advisor, a secondary advisor may also be chosen later. The student is expected to start her coursework in consultation with her advisors.

In certain unavoidable cases, the advisors may be changed upon written request from the student. It is important that the student finds an alternative advisor before submitting a change of advisor request.

CREDIT REQUIREMENT AND COURSEWORK

For PhD students who have an M.Tech./MDes/MBA/MD/MVSc/MPharma degree, the minimum requirement is 144 credits, out of which at least 36 credits should be through regular post-graduate courses and at least 72 credits should be through research.

In case of PhD students holding a B.Tech./BS/MSc/MCA degree, the minimum requirement is 216 credits, out of which 36 credits should be through post-graduate courses and at least 72 credits should be through research.

A typical course is considered to be of 9 credits. All the courses in the PhD program are electives. A large number of electives are offered each semester. The exact courses offered will depend on the availability of faculty members in a particular semester.

To continue in the PhD program, the student needs to maintain a CPI of at least 6.5.

COMPREHENSIVE EXAMINATION

Students registered in the Ph.D. programme must pass a comprehensive examination designed to test the overall comprehension of the student in the various subjects. A student can appear in the comprehensive examination only after he/she has completed the course requirements and satisfied the minimum specified CPI requirement. The comprehensive exam is conducted by a committee that includes the thesis advisor(s), at least two other members from the department and one institute faculty member outside the department.

The examination will be in the oral form but may be supplemented with a written component. The specific format of the comprehensive examination is decided by the committee.

A PhD student must pass the comprehensive examination within four months of completing the minimum credits through coursework. In no case, the date of passing the comprehensive examination should go beyond four semesters after the first registration.

STATE-OF-THE-ART SEMINAR

Once a PhD student passes the comprehensive examination successfully, she is admitted to the candidacy for the Ph.D. degree. Every Ph.D. candidate is required to give a general seminar in the department covering the State of Art of the area of research. This seminar must be given within six months of passing the comprehensive examination.

DOCTORAL DISSERTATION

Each doctoral student must produce a dissertation that demonstrates their ability to conduct original, independent research and make a meaningful contribution to the body of knowledge in their main field of study. Ideally, the dissertation should be based on research papers published in reputable venues related to intelligent systems, including but not limited to

- Conferences such as AAAI, IJCAI, AAMAS, ICAPS, ICML, NeurIPS, ICLR, SIGIR, WWW, KDD, ACL, EMNLP, NAACL, CVPR, ICCV, EMSOFT, RTSS, RTAS, ICCPS, HSCC, CDC, ACC, ICRA, IROS, RSS, MobiCom, MobiSys, SenSys, CCS, IEEE S&P, USENIX Security, FSE, ICSE, ASE, CHI, and UBIComp.
- Journals such as IEEE TRO, IEEE TWC, IEEE TCOM, ACM TECS, AIJ, and JMLR

OPEN SEMINAR

Before proceeding to finalize the thesis, each Ph.D. student must deliver an open seminar to faculty and students in which their research work will be presented. Feedback obtained from the seminar may be incorporated in the thesis before submission.

THESIS SUBMISSION AND REVIEW

The thesis has to be submitted within six months of delivering the open seminar. Once the student submits her thesis, it is sent to the oral board which includes the thesis advisor(s) and three other members. At least two members of the thesis board (other than the supervisor(s)) must be from outside the Institute and at least one of these two must be from within the country.

FINAL ORAL EXAMINATION (DEFENSE OF THE THESIS)

Once the reviews from the members of the oral board are received, the student has to address all the comments provided by them and submit the revised thesis to the PhD oral board. PhD oral board consists of four members in addition to the thesis supervisor(s). Of the four, three shall be from among the faculty members of the institute (including those, if any, on the thesis board) and one shall be from among the members of the thesis board within the country but outside the institute. Of the three members from IIT Kanpur, at least one shall be from a different department or IDP.

Finally, the student has to deliver a seminar defending her thesis in front of an open audience. The members of the oral board will attend the seminar. Upon successfully passing the oral examination, the student is conferred the PhD degree.

FINANCIAL ASSISTANCE

Non-sponsored candidates admitted to the regular full-time PhD Program who are Indian Nationals are eligible for financial assistance. Each Ph.D student is given a stipend of Rs. 37,000 per month for the first two years which increases to Rs. 42,000 per month for the next three years. Each PhD student receiving financial assistance from the institute is required to be involved in teaching activities such as being a teaching assistant or tutor for a course or research activities as assigned by the department. Any such involvement will be restricted to eight hours per week.

OPPORTUNITIES IN SPONSORED RESEARCH

Sponsored research and development activities are actively pursued in the department, with many projects addressing currently relevant problems involving advanced technologies. PhD students are encouraged to participate in these funded projects, which not only offer opportunities to work on state-of-the-art and practically meaningful topics but may also provide additional financial support.

Students are further encouraged to align their research problems with these ongoing activities, enabling them to make use of sophisticated facilities and contribute to impactful work. In special cases, qualified candidates may join projects as Research Associates and concurrently carry out both research, usually related to their thesis, and project work. Such candidates may receive remuneration higher than the standard MHRD norms for PhD scholarships.

PHD TEMPLATES

PhD in IS (PhD-IS) Template: Admission after Masters

- A total of 144 credits are required to obtain the PhD-IS degree for those who join the PhD program with M.Des., M.Tech., or MBA (with B.Tech., B.S. (4 years), M.Sc., M.A.), M.Pharm, M.D., M.V.Sc degree.
- At least 36 credits must be obtained using course work.
- At least 72 credits must be obtained using thesis work.
- A typical semester load is 36 credits, but a student may register for 27 credits.
- A student may register for 0 or 9 or 18 credits in a summer session.
- Students must take all courses in consultation with their PhD supervisor, who will ensure that the courses are relevant and do not overlap with other courses.

Semester 1	Semester 2	Semester 3-12
OE (9)	OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)
OE (9)	OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)
OE (9) /PhD Thesis (9)	PhD Thesis (9)	PhD Thesis (9)
OE (9) /PhD Thesis (9)	PhD Thesis (9)	PhD Thesis (9)
36	36	Remaining Credits

PhD in IS (PhD-IS) Template: admission after Bachelors/MSc

- A total of 216 credits are required to obtain the PhD-IS degree for those who join the PhD program after Tech., B.S. (4 years), M.Sc., M.C.A.
- At least 54 credits must be obtained from course work
- At least 72 credits must be obtained using thesis work.
- A typical semester load is 36 credits, but a student may register for 27 credits.
- A student may register for 0 or 9 or 18 credits in a summer session.
- Students must take all courses in consultation with their PhD supervisor, who will ensure that the courses are relevant and do not overlap with other courses.

Semester 1	Semester 2	Semester 3-12
OE (9)	OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)
OE (9)	OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)
OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)	PhD Thesis (9)
OE (9) /PhD Thesis (9)	OE (9) /PhD Thesis (9)	PhD Thesis (9)
36	36	Remaining Credits

CONTACT

Prof. Ketan Rajawat, DPGC Convenor

Email: ketan@iitk.ac.in

Phone: +91 512-679-7337

Prof. Indranil Saha, Head

Email: head_is@iitk.ac.in

Phone: +91 512-679-6343



Scan for the website

Webpage: <https://iitk.ac.in/dis/phd-admission>