

KCDH Proposed Ph. D. topics for Admission : 2023-2024

1. **Using Machine learning approaches for analyzing and enhancing molecular dynamics simulation of interaction of microtubule and microtubule associated proteins**

Research area of project - Computational Biology and Bioinformatics

Supervisor - Prof. Ambarish Kunwar

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~akunwar/>

2. **Motion planning and control of disinfection robots using machine learning**

Research area of project - Healthcare Applications

Supervisor - Prof. Ambarish Kunwar

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~akunwar/>

3. **Computational modeling of tumor heterogeneity and cancer invasion**

Research area of project - Computational Biology and Bioinformatics

Supervisor - Prof. Shamik Sen

Webpage of the supervisor - <http://www.bio.iitb.ac.in/~shamik>

4. **Image reconstruction in cryo-electron microscopy**

Research area of project - Healthcare Applications, Computational Biology and Bioinformatics:, Biological image reconstruction

Supervisor - Prof. Ajit Rajwade

Webpage of the supervisor - <https://www.cse.iitb.ac.in/~ajitvr/>

5. **Computing and decision-making inside a cell nucleus**

Research area of project - Computational Biology and Bioinformatics

Supervisor - Prof. Ranjith Padinhateeri

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~ranjith/>

6. **Development of wearable healthcare devices**

Research area of project - Healthcare Applications

Supervisor - Prof. Dipti Gupta

Webpage of the supervisor - <https://sites.google.com/site/plasticoptoelectronicslab/home/professor>

7. Development of wearable Neuro Devices

Research area of project - Healthcare Applications

Supervisor - Prof. Dipti Gupta

Webpage of the supervisor -

<https://sites.google.com/site/plasticoptoelectronicslab/home/professor>

8. Development and Integration of Human Brain Disease Network (HBDN) in BrainProt™ (<http://www.brainprot.org/>).

Research area of project - Healthcare Analytics and AI/ML., Computational Biology and Bioinformatics

Supervisor - Prof. Sanjeeva Srivastava

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~sanjeeva/>

9. Development of Wearable Electronic devices for Screening/diagnosing Neuro disorders

Research area of project - Healthcare Applications

Supervisor - Prof. Dipti Gupta

Webpage of the supervisor -

<https://sites.google.com/site/plasticoptoelectronicslab/home/professor>

10. Developing computational algorithms for cerebral metabolism and blood flow imaging in humans using near infrared spectroscopy.

Research area of project - Healthcare Applications, Healthcare Analytics and AI/ML.

Supervisor - Prof. Hari M Varma

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~harivarma/>

11. Using Machine learning approaches for analyzing and enhancing molecular dynamics simulations of motor proteins and microtubule interactions

Research area of project - Computational Biology and Bioinformatics

Supervisor - Prof. Ambarish Kunwar

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~akunwar/>

12. Development and application of machine learning algorithms for biomedical signal processing and control of prosthetics

Research area of project - Healthcare Applications

Supervisor - Prof. Ambarish Kunwar

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~akunwar/>

13. Computational Fluid Dynamics (CFD) Analyses of Blood Flow in Diseased Vasculature

Research area of project - Healthcare Applications, Healthcare Analytics and AI/ML., Computational Biology and Bioinformatics

Supervisor - Prof. Janani Srree Murallidharan

Webpage of the supervisor -

<https://www.me.iitb.ac.in/?q=faculty/Prof.%20Janani%20Srree%20Murallidharan>

14. Public Health Insurance in India: Addressing issues related to access, utilization, and equity

Research area of project - Population Health & Public Health Policy

Supervisor - Prof. Souvik Banerjee

Webpage of the supervisor - <https://www.economics.iitb.ac.in/souvik.html>

15. Machine Learning augmented NMR Spectrum Recognition for Biopharmaceutical

Research area of project - Healthcare Analytics and AI/ML.

Supervisor - Prof. Ashutosh Kumar

Webpage of the supervisor - <https://www.bio.iitb.ac.in/~ashutoshk/>

Co-supervisor - Prof. Manjesh K Hanwal

Webpage of the Co-supervisor - <https://www.ieor.iitb.ac.in/files/faculty/mhanawal/index.html>

16. Investigating transmission and burden of certain diseases through Disease Modeling

Research area of project - Disease Modeling

Supervisor - Prof. Usha Ananthakumar

Webpage of the supervisor - <https://www.som.iitb.ac.in/?p=985>

17. Evaluating age specific changes in P300 Evoked response potential using iCognitive device and physiological reactions measured using wearable devices

Research area of project - Healthcare Applications

Supervisor - Prof. Kshitij Jadhav

Webpage of the supervisor - <https://www.kcdh.iitb.ac.in/people/faculty.htm>

Co-supervisor - Prof. Ganesh Ramakrishnan

Webpage of the Co-supervisor - <https://www.cse.iitb.ac.in/~ganesh/>

18. Evaluating the difference between Mild cognitive impairment, Alzheimer's disease and healthy controls in P300 ERP using iCognitive Device and physiological reactions measured using wearable devices.

Research area of project - Healthcare Applications

Supervisor - Prof. Ganesh Ramakrishnan

Webpage of the supervisor - <https://www.kcdh.iitb.ac.in/people/kcdh-team.htm>

Co-supervisor - Prof. Kshitij Jadhav

Webpage of the Co-supervisor - <https://www.kcdh.iitb.ac.in/people/faculty.htm>

19. Prompt Learning and Data Efficient Machine learning for Fine-grained and Long-tail Medical Dataset

Research area of project - Healthcare Applications

Supervisor - Prof. Kshitij Jadhav

Webpage of the supervisor - <https://www.kcdh.iitb.ac.in/people/faculty.htm>

Co-supervisor - Prof. Ganesh Ramakrishnan

Webpage of the Co-supervisor - <https://www.cse.iitb.ac.in/~ganesh/>

20. In Silico Design of Small Interfering RNAs for Therapeutic RNAi

Research area of project - Computational Biology and Bioinformatics

Supervisor - Prof. Pradeepkumar P.I.

Webpage of the supervisor - <https://www.chem.iitb.ac.in/~pradeep/>

21. Predicting Alzheimer Symptoms Using Using Machine Learning Models

Research area of project - Healthcare Applications, Healthcare Data Management, Healthcare Analytics and AI/ML.

Supervisor - Prof. Azizuddin Khan

Webpage of the supervisor - <https://www.aziziitblab.co.in>

22. Development of Digital Device for Screening and Diagnosis of Dyslexia Using AL/ML

Research area of project - Healthcare Applications, Healthcare Data Management, Healthcare Analytics and AI/ML.

Supervisor - Prof. Azizuddin Khan

Webpage of the supervisor - <https://aziziitblab.co.in>

23. AI/ML enabled rapid bio-marker recognition algorithms

Research area of project - Healthcare Applications

Supervisor - Prof. Siddhartha Prakash Duttagupta

Webpage of the supervisor - <https://www.ee.iitb.ac.in/web/people/siddhartha-p-dutttagupta/>

Co-supervisor - Prof. Sanjeeva Srivastava

Webpage of the Co-supervisor - <https://www.bio.iitb.ac.in/people/faculty/srivastava-s/>

24. Experimental and computational studies on expiratory events like coughing and sneezing

Research area of project - Airborne transmission of infectious diseases

Supervisor - Prof. Hrishikesh Gadgil

Webpage of the supervisor - <https://www.aero.iitb.ac.in/home/people/faculty/gadgil>

Co-supervisor - Prof. Sudarshan Kumar

Webpage of the Co-supervisor - <https://www.aero.iitb.ac.in/home/people/faculty/sudar>

25. Theranostic device development for diabetes monitoring and regulated drug delivery

Research area of project - Healthcare Applications

Supervisor - Prof. Shobha Shukla

Webpage of the supervisor - <https://www.iitb.ac.in/mems/en/prof-s-shukla>

Co-supervisor - Prof. Sumit Saxena

Webpage of the Co-supervisor - <https://homepages.iitb.ac.in/~sumit.saxena/>

26. Development of IoT Enabled Sensor for Heavy Metal Detection

Research area of project - Healthcare Applications

Supervisor - Prof. Sumit Saxena

Webpage of the supervisor -
<https://homepages.iitb.ac.in/~sumit.saxena/people.html>

Co-supervisor - Prof. Shobha Shukla

Webpage of the Co-supervisor -
<https://homepages.iitb.ac.in/~sshukla/people.html>

27. Impact of AR and Health Gamification on Sports Rehabilitation and Performance Training

Research area of project - Healthcare Applications

Supervisor - Prof. Nirmal Punjabi

Webpage of the supervisor - <https://www.kcdh.iitb.ac.in/people/kcdh-team.htm#verticalTab4>

Co-supervisor - Prof. Ganesh Ramakrishnan

Webpage of the Co-supervisor - <https://www.cse.iitb.ac.in/~ganesh/>

28. Applications of machine learning in analyzing higher-order mass spectrometry metabolomics data.

Research area of project - Healthcare Applications

Supervisor - Prof. [Pramod P Wangikar](#)

Webpage of the supervisor - <https://www.che.iitb.ac.in/index.php/group/wangikar-lab>

Description: Liquid chromatography coupled with mass spectrometry (LC-MS) is a very popular technique that can be used to simultaneously analyze thousands of proteins or metabolites in biological samples. The latest LC-MS instruments acquire higher dimension data that includes orthogonal properties such as chromatographic retention time (RT), mass to charge ratio (m/z), tandem MS data (MS2) and collision cross sectional area (CCS values). With such high dimensionality, data analysis becomes quite cumbersome. Further, the signals need to be ascribed to known compounds based on matches with the compound libraries. Further, experimentally determined values of MS2 and CCS are available only for a limited number of compounds compared to the available chemical space. Thus, with the limited labelled data, data-efficient machine learning tools need to be developed including quantitative structure property relationships (QSPR) in the domain of metabolomics. The following articles may be explored that describe similar problems in the domain of interest. <https://www.nature.com/articles/s41467-020-18171-8> or <https://www.nature.com/articles/s41467-021-21352-8> The candidate must have a strong foundation in AI/ML apart from the willingness to work in cross-disciplinary areas.

29. Automated feature selection for biomarker discovery from big biological data.

Research area of project - Healthcare Applications

Supervisor - Prof. [Pramod P Wangikar](#)

Webpage of the supervisor - <https://www.che.iitb.ac.in/index.php/group/wangikar-lab>

Description: Proteins and metabolites, the new class of biomarkers are expected to bring a paradigm shift in the diagnosis, monitoring and treatment of human disease and will make personalized medicine a reality in near future. Moreover, the next generation biomarkers are likely to be based on the inference drawn from multiple metabolite or protein molecules rather than single measurements such as the blood glucose level that is currently used for the diagnosis of diabetes. The present project focuses on the discovery of biomarkers from big biological data involving genomics, proteomics or metabolomics. Our primary objective will be to select the best combination of biomarkers or minimum subset of features to predict class labels such as disease vs. healthy or one category of disease vs. another. The challenges include: (i) small amount of labelled data, (ii) unbalanced data with too many features and too few samples, (iii) the need to learn to predict classes that may have only subtle differences, and (iv) high degree of inherent biological variability (unrelated to the class label) and instrument noise. We will use a number of feature selection methods and machine learning tools together with the concepts of multitask learning to achieve the task of biomarker discovery. A large number of public domain databases are available that will be used as test cases. See a recently published paper to understand the broad objectives of the proposed project (<https://www.frontiersin.org/articles/10.3389/fgene.2019.00452/full>). You may also see literature on multitask machine learning. The candidate must have a strong foundation in AI/ML/data science apart from the willingness to work in cross-disciplinary areas.

30. Metabolomics-based identification of novel biomarkers for early diagnosis of chronic kidney disease

Research area of project - Healthcare Applications

Supervisor - Prof. [Pramod P Wangikar](#)

Webpage of the supervisor - <https://www.che.iitb.ac.in/index.php/group/wangikar-lab>

Description: Chronic kidney disease (CKD), characterized by progressive loss of kidney function, is a major global health issue, especially among diabetes patients. Advanced CKD is associated with an increased risk of cardiovascular complications, and may necessitate hemodialysis or renal transplantation. However, current diagnostic tests employed for CKD, i.e. serum creatinine and urine albumin measurement, are prone to variability and error. In addition, they do not provide a definitive diagnosis and classification of the initial asymptomatic stages of CKD. Metabolomics analysis can highlight alterations in metabolite levels associated with disease onset and progression, and can be used to identify biomarkers that would be indicative of early stage CKD. The work would involve the LCMS and GCMS analysis of metabolites from blood plasma and urine samples of patients, followed by statistical analysis to identify and validate potential biomarkers for

CKD. These biomarkers would be further correlated with biochemical pathways and known clinical and demographic factors with the goal of understanding disease mechanisms and developing a sensitive and accurate diagnostic test for CKD. The project is in collaboration with Dr. Rakesh Sahay (Professor & Head, Department of Endocrinology, Osmania Medical College & Osmania General Hospital, Hyderabad) and Dr Manisha Sahay (Professor and Head, Department of Nephrology, Osmania Medical College & Osmania General Hospital, Hyderabad).