

## About IIT Kharagpur



Kharagpur - a dusty town tucked away in the eastern corner of India, famous until 1950 as home to the longest railway platform in the world - became the nursery where the seed of the IIT system was planted in 1951. IIT Kharagpur started its journey in the old Hijli Detention Camp in Eastern India, where some of the country's great freedom fighters toiled and sacrificed their lives for India's independence. Spurred by the success of IIT Kharagpur, four younger IITs sprouted around the country in the two following decades, and from these five came thousands of IITians, the brand ambassadors of modern India. It was the success of this one institution at Kharagpur that wrote India's technological odyssey.

The Institute takes pride in its relentless effort to provide the best platform for both education as well as research in the areas of science and technology, infrastructure designs, entrepreneurship, law, management, and medical science and technology. IITKGP is not just the place to study technology, it is the place where students are taught to dream about the future of technology and beam across disciplines, making differences enough to change the world.

### Program Features/ Structure

This course complements the already existing standard courses such as Matrix Theory and Linear Algebra which do not explore the computational aspects and applications in details.

### Program Schedule and Venue

1 week, 17 – 23 September  
2019 (9:30 AM – 6 PM)

IIT Kharagpur –  
Department of  
Mathematics

### Program Fee

Nil for AICTE-QIP  
sponsored participants

For others –  
**Industry - INR 10,000/-**  
(ten thousand) + GST  
@18% per participant  
**Student – INR 5000/**  
(five thousand) + GST  
@18% per participant

### Who will benefit (Eligibility)

Teachers of AICTE approved  
degree level colleges,  
industry participants,  
Students and researchers.

### Last day of Registration

# 15

July 2019

### Accommodation

Accommodation will be  
provided to the AICTE-QIP  
sponsored participants at  
the campus Guesthouse. For  
other participants, the same  
will be provided on  
chargeable basis as per rule.

## How to Apply

Use the link: <https://erp.iitkgp.ac.in/CEP/courses.htm> to apply  
ONLINE.



Payment if applicable is to be done **ONLINE** after getting short listed for the program.

## Contact Us

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# AICTE QIP QUALITY IMPROVEMENT PROGRAMME

Indian Institute of Technology Kharagpur  
2019

## ADVANCED MATRIX ALGEBRA AND APPLICATIONS

1 Week

17 – 23 September 2019

## Introduction / Overview

Matrix algebra plays a key role in a lot of application areas such as electrical and electronics engineering, computer science and engineering, industrial engineering to name a few. This course complements the already existing standard courses such as Matrix Theory and Linear Algebra which do not explore the computational aspects and applications in details.

## Program Objectives

This course is intended for audience who are mathematicians as well as engineers with a little background in matrix algebra. We provide an introduction to basic concepts in this area and cover important decompositions such as spectral decomposition, LDU, QR and SVD. We illustrate the applications of these decompositions in solving the system of linear equations, least squares problems and eigenvalue problems. Advanced concepts such as the proof of SVD as an application of spectral theorem, condition numbers, sensitivity analysis are also covered which have practical significance. A variety of numerical techniques related to the theory will be discussed. Also, this gives a scope to have some hands on experience on computations using PYTHON.

## What you will learn

### Program Content

- Introduction to vectors and matrices, norm, matrix vector multiplication, complexity
- Rank, Nullity, Row span, Column span, eigenvalues and eigenvectors of a square matrix
- Inner product and orthogonality
- Spectral representation of semi-simple matrices
- Spectral theorem for symmetric matrices and its applications
- Linear equations: Gaussian elimination, LDU decomposition, Cholesky decomposition
- Condition number and sensitivity results
- QR factorization, Least Squares (LS) problem and solution
- Singular Value Decomposition and its applications
- Low rank approximations and Sensitivity results for LS problem

## About the Faculty Coordinator

### Dr Swanand Khare

Dr. Swanand Khare obtained M.Sc. and Ph.D. degrees from IIT Bombay in 2005 and 2011 respectively. He was a post-doctoral researcher in the University of Alberta, Canada from 2011 to 2014 and then subsequently joined as an assistant professor in the Department of Mathematics at IIT Kharagpur. His research interests include inverse problems, computational linear algebra, estimation and computational issues in applied statistics. He is currently the principal investigator of three research projects funded by the Government of India as well as industry. He is a recipient of Excellent Young Teacher Award 2018 at IIT Kharagpur.

### Dr M Rajesh Kannan

Dr. M. Rajesh Kannan obtained his Ph.D. from IIT Madras in 2013. He was a postdoctoral fellow at Indian Statistical Institute, Delhi (2013-2014), The Technion-Israel Institute of Technology (2014-2015), Haifa, Israel and University of Manitoba, Winnipeg, Canada (2015-2016). He joined as an assistant professor in the Department of Mathematics, IIT Kharagpur in July 2016. His research interests include matrix theory and spectral graph theory. He is currently the principal investigator of three research projects.