CS 6015: Linear Algebra and Random Processes

Odd Semester: Jul.-Nov. 2026; Class Room: SSB134 ; D Slot:
M: 11:00 – 11:50 AM; Tu: 10:00 – 10:50 AM; W: 9:00 – 9:50 AM; Th: Noon – 12:50 PM
Prof. Krishna Sivalingam, SSB 313; Phone: 4378
Email: *skrishnam@cse.iitm.ac.in, krishna.sivalingam@gmail.com*
Teaching Assistant(s): TBA
URL: `http://courses.iitm.ac.in/` (Moodle Site)

1 Course objectives

The objective of this course is to provide an extensive introduction to (i) Linear Algebra and (ii) Probability Theory and Random Processes, relevant to Computer Science with applications to real world problems, especially with respect to machine learning.

2 Course credit structure

The course credits are: Lecture (3) + Tutorial (1) + Other (8), for a total of 12 hours per week. The tutorial session can be conducted during any one of the four slots in a week.

3 Course prerequisite(s)

The student MUST be enrolled in a post-graduate level program in Engineering at IIT Madras; Non-IITM-Students MUST have completed an undergraduate program in Engineering or Science.

This course is NOT available for: (i) currently enrolled undergraduate students; (ii) currently enrolled M.Sc. (Mathematics) students; (iii) students in other similar programs; (iv) those who have completed or concurrently enrolled in equivalent courses such as DA5000.

4 Required Textbooks

GS4 "Linear Algebra and Its Applications", Gilbert Strang, Cengage, Fourth Edition.

LLM "Linear Algebra and Its Applications", David C. Lay, Steven R. Lay, Judi J. McDonald, Pearson, 2023.

KT K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", Wiley.

5 Reference Textbooks/Others

GSLA "Introduction to Linear Algebra", Gilbert Strang, Fifth Edition.

HK "Linear Algebra", Kenneth Hoffman and Ray Kunze, Prentice Hall India, 2015.

CJ "Linear Algebra: Theory and Applications", Ward Cheney and David Kincaid, Jones and Bartlett learning, 2010.

EG "Linear Algebra: Pure and Applied", Edgar Goodaire, Cambridge University Press India, 2014.

FIS "Linear Algebra", Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Pearson, 2022.

BT "Introduction To Probability", by Dimitri P. Bertsekas and John N. Tsitsiklis, `https://www.mit.edu/~dimitrib/probbook.html`

GS "Probability and random processes", Geoffrey Grimmett and David Stirzaker, OUP Oxford, 2001.

SR "Probability and Statistics for Engineers and Scientists", Sheldon Ross, Academic Press, 2024.

YG "Probability and Stochastic Processes", Roy D. Yates and David J. Goodman, Wiley, 2021.

6 Course Requirements

You are *required* to attend all the lectures. If you miss any of them it is your responsibility to find out what went on during the classes and to collect any materials that may be handed out.

Course related announcements will be made in class (primarily), via IITM Moodle, and occasionally by email to your IITM mail ID. It is your responsibility to monitor/forward your IITM email accounts regularly; please check your 'smail' IDs at least once daily, if not more often.

IITM's prevailing attendance policy for assigning attendance grades will be applied.

Class participation is strongly encouraged to demonstrate an appropriate level of understanding of the material being discussed in the class. Regular feedback from the class regarding the lectures will be very much appreciated.

All individual assignments must be done individually! Suitable action will be taken, as per IITM policy, in case of any type of code-sharing, downloaded-code submission and other forms of academic dishonesty, in the tutorials, quizzes, assignments and exams.

7 Planned Syllabus

The following topics will be covered, but not necessarily in the order listed below:

Matrices: Matrices, Matrix Multiplication, System of Linear Equations, Gaussian Elimination, Triangulation, Inverses and Transposes

Vector Spaces: Vector Spaces and Subspaces, Solving $Ax = 0$ and $Ax = b$, Linear Independences, Four Fundamental Subspaces, LinearTransformations

Orthogonality: Orthogonal Vectors and Subspaces, Projections, Least Squares, Orthogonal Bases and Gram-Schmidt

Determinants: Properties, Formulas, Applications

Eigenvalues and Eigenvectors: Diagonalization

Miscellaneous: Principal Component Analysis (and time permitting, Singular Value Decomposition)

Random Variables: Discrete and Continuous; Joint, Conditional, and Marginal

Stochastic Processes: Markov Chains.

8 Tentative Grading Policy

The following allocation of points is tentative. These may change during the semester.

Component	Weight
Attendance: VG (5); G (4); M (2); P (0)	5%
Quiz 1 (Sep. 3, 8:00 – 8:50AM); E/D Exchange	15%
Quiz 2 (Oct. 15, 8:00 – 8:50AM); E/D Exchange	15%
Final Exam (Nov. 16, 2:00 – 5:00PM)	45%
In-Class Tutorials (Best 10)	20%

Relative grading will be done to obtain course grade.

9 Other Policies

- Attendance will be taken during each class. Marks will be awarded for attendance as described above.
- Students arriving after FIVE minutes from start of class will not be given attendance credit, but will be allowed to listen to the lecture.
- Since this is an elective, there will be NO supplementary final exam, in case a student receives the 'U' grade. There will be NO upgrade from 'E' grade either since there is no equivalent NPTEL or other course at present.
- No mobile phones, tablets, laptops and other computing devices should be used during the class. Class notes, if written down, must be in regular paper notebooks.
- If any mobile device is used in the class, it will be confiscated and handed over to "Lost and Found" in Security Section, from where you can claim the same later on.
- Makeup exam for quizzes and final exam is ONLY permitted for sickness (with valid IITM Hospital Certificate) or under extraordinary circumstances (with valid proof).
- **Absolute adherence to policies regarding conduct during Quiz/Exam is required.** Students who violate the Academic Honor Code will be reported to the IITM Senate-appointed Students Discipline and Welfare Committee, for necessary action.
- **Please protect your Moodle/Smail/other account passwords. Do not share it with ANYONE. Do not share your academic disk drive space on the Campus LAN or on the Cloud such as Google Drive (ClassRoom), Dropbox, Github, etc.**