Math 1

- **Course no:** MTH100 **Section A**
- **Course title:** Math I **Credits:** 4
- **Semester: 2023-24 Monsoon**
- **Timetable: MON, WED 11:00, FRI 09:30**
  - **Tutorial:** TBA
- **Instructor:** Samaresh Chatterji
- **Email:** samaresh@iiitd.ac.in
- **Office:** B303 Academic Bldg, Extension: 487
- **Office Hours: TBA**

COURSE OUTLINE

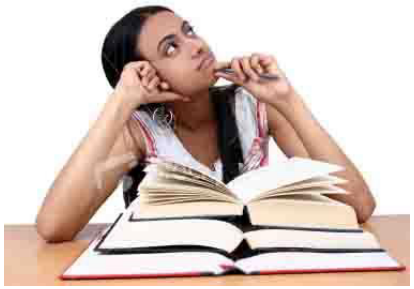
- The Course Outline contains the essential information regarding the course. Two versions will soon be uploaded on the MTH100A Classroom page:
- MTH100_Math 1_outline_STANDARD – EXCEL file (official format required by Institute)
- MTH100_Math 1_outline_STUDENT – pdf file (slightly more detailed, easier to read)
- Today we will briefly cover the main points of the course outline

What Is Linear Algebra ?

- **Informal Answer**: It is the branch of mathematics which deals with vector spaces, vectors, linear transformations and operators, matrices, and related concepts.
- **Remark**: A more formal abstract is included in the official outline, which you may refer to if desired.
- ***Why Is Linear Algebra in Semester 1 ?***
- ***Why is Learning Linear Algebra Important ?***

Purpose of Learning Outcomes: Students

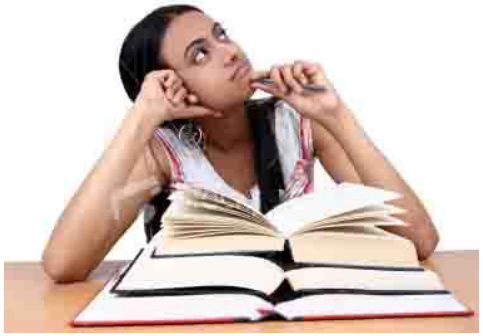
- Due to lack of time, slides 4 to 7 were noit covered in class. Read through them, and ask in the next class if you have any queries.
- Learning outcomes help students
  - Clarify their personal course goals
  - Provide framework for measuring their success
  - Reduce their anxiety
  - Improve their studying effectiveness



Source - http://ublib.buffalo.edu/libraries/projects/tlr/importance.html

Learning Outcome Guidelines

- Outcome must:
  - Contain a **verb** describing an observable action
  - Focus on the student as the performer
    - What is a student expected to be able to do?
    - How is a student expected to be able to think?

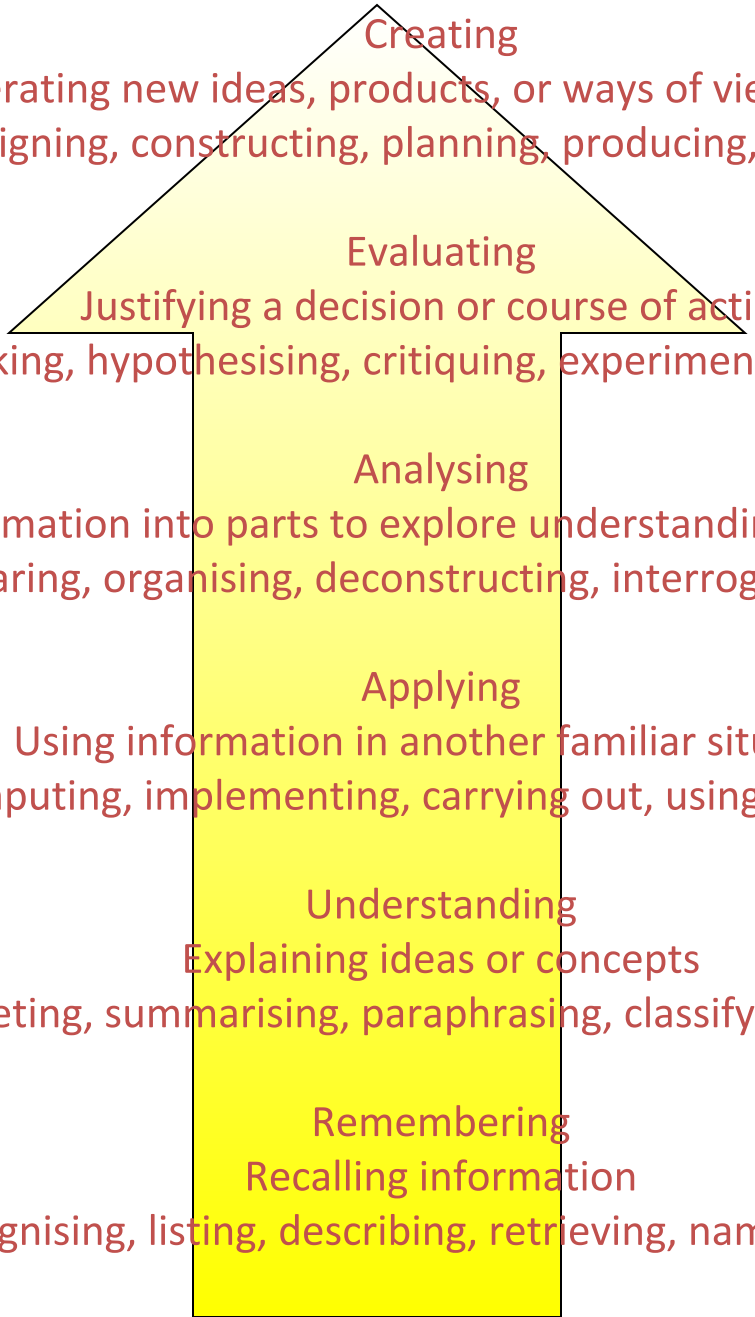


Bloom's Revised Taxonomy

- Creating
- Evaluating
- Analyzing
- Applying
- Understanding
- Remembering

BLOOM'S REVISED TAXONOMY

Higher-order thinking



Creating
Generating new ideas, products, or ways of viewing things
Designing, constructing, planning, producing, inventing.

Evaluating
Justifying a decision or course of action
Checking, hypothesising, critiquing, experimenting, judging

Analysing
Breaking information into parts to explore understandings and relationships
Comparing, organising, deconstructing, interrogating, finding

Applying
Using information in another familiar situation
Computing, implementing, carrying out, using, executing

Understanding
Explaining ideas or concepts
Interpreting, summarising, paraphrasing, classifying, explaining

Remembering
Recalling information
Recognising, listing, describing, retrieving, naming, finding

Post-Conditions, i.e. Outcomes

- **Students will be able to:**
- **CO1: Compute the following using the applicable results/methods: (details in outline)**

- **CO2: Test/classify for the following using the given criteria or test: (details in outline)**

- **CO3: Determine the truth/falsity of statements involving the following concepts and justify or explain the answer using any of the techniques/results covered up to date: (details in outline)**

- **CO4: Construct proofs for statements involving the above concepts using any of the results covered up to date**

CO1: Compute the following using the applicable results/methods:

- **As an example, some details for CO1 are given here:**
- RREF of a matrix
- Solution in vector form of a linear system (homogeneous or non-homogeneous)
- LU decomposition of a matrix
- Inverse of a matrix
- Dimension of a vector space/subspace
- Complementary subspace for a given subspace
- Dimension and basis for the fundamental subspaces of a matrix
- Matrix of a given linear transformation/operator
- Change of basis matrix and matrix of an operator after change of basis
- Etc, etc

Contents Week-Wise - 1

- The weekly contents, i.e. the topics to be covered in a particular week of the semester, are listed in the course outline.
- However, note that this is **indicative** only. In actuality, there will be variations as we proceed. **If a listed topic is not covered in class, that means you are not required to be familiar with it.** *Exception: Once in a while, a topic is supposed to be covered by self-study. You will be informed explicitly and are required to be familiar with these.*

Contents Week-Wise - 2

- **Contents Week-Wise:**
- **Weeks 1/2:** Systems of linear equations, row reduction and echelon
- forms, matrix equation of the form A**x** = **b**, invertibility of matrices
- **Weeks 3/4/5:** Vector spaces and subspaces, linear dependence/independence, dimension, span,
- applications. Fundamental subspaces.
- **Weeks 6/7/8:** Linear transformation, rank. Matrix of linear transformation, effect of change of basis, similarity transformation. Algebra of linear transformations. Determinants, properties of determinants, Cramers rule, volume. .
- **Weeks 9/10:** Eigenvalues and eigenvectors, diagonalization of a matrix, eigenvectors and linear transformations, complex eigenvalues.
- **Weeks 11/12/13:** Orthogonality and least squares, inner product, length, orthogonal projections, Gram-Schmidt orthogonalization, QR decomposition. Symmetric matrices and Quadratic forms, diagonalization of symmetric matrices, positive definite matrices, SVD, application to image processing.

Continuous Assessment

- **Evaluation:** Class test (10%), Mid-semester exam (20%), weekly tutorial submissions and occasional quizzes (30%), end-semester exam (40%). Weightage of the above components may be adjusted by not more than 5%.

- **Grading:** A – 75%, B – 60%, C – 45%, D – 30%. These cut-off points may be adjusted by not more than 5%.

Resources

- **Textbook:**
- David Lay: Linear Algebra and Its Applications, 3rd (Indian Edition), Pearson.

Reference Books:

1. Strang: Linear Algebra and Its Applications, 4th Edn, Cengange.
2. Lipschutz: Linear Algebra, Schaum's Outline Series.
3. Hoffman & Kunze: Linear Algebra, Pearson.
4. Kumaresan: Linear Algebra: A Geometric Approach, Prentice-Hall.
5. Axler: Linear Algebra Done Right, Springer. (Advanced)
6. Halmos: Finite-Dimensional Vector Spaces, Springer. (Advanced)

* *There are numerous books on linear algebra. You may use any other book if you prefer, but will have to be careful about terminology, definitions, and notation.*

NB: Details are in the course outline document