| MAT3004 | Applied Linear Algebra | L | T | P | J | C |
|---------|------------------------|---|---|---|---|---|
| | | 3 | 2 | 0 | 0 | 4 |
| **Pre-requisite** | **MAT2002    Applications of Differential and Difference Equations** | Syllabus Version | | | | |
| | | **1.1** | | | | |

**Course Objectives**

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. Solve problems in cryptography, computer graphics and wavelet transforms

**Course Outcomes**

At the end of this course the students are expected to learn
1. the abstract concepts of matrices and system of linear equations using decomposition methods
2. the basic notion of vector spaces and subspaces
3. apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. applications of inner product spaces in cryptography
5. Use of wavelet in image processing.

| **Student Learning Outcomes(SLO)** | **1,2,7** |
|---|---|

| **Module:1** | **System of Linear Equations** | **6 hours** |
|---|---|---|

Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - - LU factorizations.

| **Module:2** | **Vector Spaces** | **6 hours** |
|---|---|---|

The Euclidean space $R^n$ and vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space.

| **Module:3** | **Subspace Properties** | **6 hours** |
|---|---|---|

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

| **Module:4** | **Linear Transformations and applications** | **7 hours** |
|---|---|---|

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity

| **Module:5** | **Inner Product Spaces** | **6 hours** |
|---|---|---|

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation

| **Module:6** | **Applications of Inner Product Spaces**: | **6 hours** |
|---|---|---|

| | QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes | |
|---|---|---|
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| **Module:7** | **Applications of Linear equations** : | **6 hours** |
| | An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets  (only approx. of Wavelet from Raw data) | |
| | | |
| **Module:8** | **Contemporary Issues:** | **2 hours** |
| | Industry Expert Lecture | |
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| | **Total lecture hours:** | **45 hours** |
| **Tutorial** | • A minimum of 10 problems to be worked out by students in every Tutorial Class<br>• Another 5 problems per Tutorial Class to be given as home work. | **30 hours** |

**Text Book(s)**

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

**Reference Books**

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker,  5th  Edition, Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, GuterPilz, 2nd  Edition,  Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4. Introduction to Linear Algebra, Gilbert Strang,  5th Edition, Cengage Learning (2015).

**Mode of Evaluation:** Digital Assignments, Continuous Assessments, Final Assessment Test

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| Recommended by Board of Studies | 25-02-2017 | | |
| Approved by Academic Council | No. 47 | Date | 05-10-2017 |