

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI – K.K. BIRLA GOA CAMPUS**  
**SECOND SEMESTER 2022-2023**  
**Course Handout (Part II)**

**Date: March 13, 2023**

In addition to Part I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

**Course Number** : MATH F112  
**Course Title** : MATHEMATICS-II  
**Instructor-in-charge** : J.K. Sahoo  
**Instructors** : Prof. J.K. Sahoo, Prof. Amit Setia, Dr. Pradeep B., Dr. Monojit Bhattacharjee, Dr. Gunja Sachdeva, Dr. Saranya. G. Nair, Prof. Prasanna Kumar, Prof. Anil Kumar, Prof. P. Danumjaya, Dr. Minhajul  
**Tutorial Instructors** : Singh Ram Surendra, Rakib Mondal, Basil Paul, Saroja Kumar Panda, Sandhya Maurya, Bibekananda Sitha, Madankar Saurabh Ramdas, Abhishek Yadav, Debendra Prasad Panda, Geet Verma, Shravani V Shetgaonkar, Fathima Safikaa S N

### 1. Scope and Objective of the Course:

The course is meant as an introduction to Linear Algebra, and the theory of Complex Variable functions. Study of linear algebra helps us in solving the system of linear equations and various properties of linear transformations. Systems of linear equations are needed to be solved in several branches of science and engineering. Complex analysis deals with solving contour integrals, which cannot be evaluated through our conventional techniques. Students are encouraged to study MATLAB's capabilities for solving linear algebra problems given in the Text Book.

### 2. Text Books:

- a. H. Anton and Chris Rorres, *Elementary Linear Algebra with Supplemental Applications*, 11ed, ISV, John Wiley & Sons, 2017. ISBN: 9788126562961.
- b. R.V. Churchill and J.W. Brown, *Complex Variables and applications*, McGraw-Hill, 8th edition, 2014.

### 3. Reference Books:

- a. J. Defranza and D. Gagliardi, *Introduction to Linear Algebra with applications*, McGraw-Hill Education, 2012.
- b. G. Williams, *Linear Algebra with applications*, 8<sup>th</sup> Edition, Jones & Bartlett Learning, 2014.
- c. B. Kolman and D.R. Hill, *Introductory Linear Algebra with Applications*, Pearson Education, 8th edition, 2005.
- d. A.D. Wunsch, *Complex Variables with Applications*, Pearson Education, 3rd edition, 2005.

### 4. Course Plan:

Lec. No.	Learning Objectives	Topics to be covered	Sec. No.
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#### Linear Algebra

1-4	Solving system of linear equations	Introduction to Systems of Linear Equations, Gaussian Elimination, Elementary Matrices and a Method for Finding inverse	1.1, 1.2, 1.5
5-12	Introduction to abstract vector spaces, finite and infinite dimensional vector spaces and related concepts	Real Vector Spaces, Subspaces, Linearly Independence, Coordinates and Basis, Dimension, Change of Basis, Row Space, Column Space, and Null Space, Rank, Nullity, and the Fundamental Matrix Spaces	4.1 to 4.8
13-17	Introduction to linear transformations, examples of linear transformations	Basic Matrix Transformations in $R^2$ and $R^3$ , Properties of Matrix Transformations	4.9, 4.10
		General Linear Transformations, Compositions and Inverse Transformations, Isomorphism, Matrices for General Linear Transformations	8.1 to 8.4
18-20	Eigenvalues and Eigenvectors, Diagonalization	Eigenvalues and Eigenvectors, Diagonalization	5.1-5.2

## COMPLEX VARIABLES

	Revising the knowledge of complex numbers	Self-study	1-11
21-22	Evaluation of limit of functions of complex variables at a point. Testing continuity of such functions	Functions of a complex variable. Limit and continuity	12,15-18
23-25	Introduction to analytic functions. Finding out singular point of a function	Derivative, CR-equations, Analytic functions	19-24,26
26-29	Study of elementary functions. These functions occur frequently all through the complex variable theory, Understanding Multiple Valued Function, branch cut and branch point	Exponential, trigonometric and hyperbolic functions, Logarithmic functions, complex exponents, inverse functions	29-35
30-31	Integrating along a curve in complex plane	Contour integrals, anti-derivatives	37-43
32-34	Learning techniques to find integrals over particular contours of different functions	Cauchy-Goursat Theorem, Cauchy Integral Formula, Morera's Theorem (No proof)	44-46, 48-52
35	To study application of complex variable theory to algebra	Liouville's Theorem, Fundamental Theorem of Algebra	53-54
36-37	Series expansion of a function analytic in an annular domain. To study different types of singular points	Laurent series (No proof)	60-62
38-39	Calculating residues at isolated singular points	Residues, Residue Theorem	68-73
40-41	To study application of complex integration to improper real integral	Improper real integrals	78-81

### 5. Evaluation Scheme:

EC	Component	Duration	Marks	Nature	Date of Exam (Time)
1	Announced Quiz-1*	60 Minutes	75	Open Book	12-04-2023 (6.00PM-7.00PM)
2	Mid-term Test	90 Minutes	105	Closed Book	As per the timetable
3	Announced Quiz-2*	60 Minutes	75	Open Book	10-06-2022 (10.30AM-11.30AM)
5	Comprehensive Exam	3 hours	120	Closed Book	As per the timetable

\*Out of two quizzes, the best one will be considered.

- Make-up Policy:** Make-up will be given only for very genuine cases, and prior permission has to be obtained from I/C. **No makeup for EC1 and EC3.**
- Chamber consultation hour:** To be announced in the class.
- Notices:** All notices regarding the course **MATH F112** will be displayed on the quanta.

**Instructor-In-Charge**