



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani Hyderabad Campus

SECOND SEMESTER 2023-2024 Course Handout (Part-II)

09-01-2024

In addition to Part-I (General Handout for all Courses appended to the time table) this portion gives further specific details regarding the Course.

Course No.: MATH F112

Course Title: MATHEMATICS-II

Instructor-In charge : Nijjwal Karak

Instructors : A Michael Alphonse, Nijjwal Karak, Anil Nemili, Debopam Chakraborty, Pratyusha Chattopadhyay, Sharan Gopal, Deepika, PK Sahoo, Jhuma Sen Gupta, TSL Radhika, K Bhargav Kumar, G Murali Mohan Reddy, Rohit Gupta, Sushil Bhunia, Ruddaraju Amrutha, Lokesh Kumar Duchaniya, Debismita Nayak, Rahul Vijay Bhagat, Ankur Pandey, Sandhya Mel, Ameya kolhatkar, Sai Swagat Mishra, Moreshwar Jagadeorao Tayde, Nitin Kumar Sharma, Akankshya Sahu, Aadiq Mohi Ud Din Bhat, Amritanshu Rai, Dheeraj Singh Rana, Shubham Atmaram Narawade, Sunita Kumawat, Mayuri Verma

1. Scope and Objective of the Course: The course is meant as an introduction to Linear Algebra and Theory of Functions of Complex Variable and their applications.

2. Course Description: System of linear equations, Eigenvalues and eigenvectors, Vector spaces, Basis and dimension of vector spaces, Linear transformations, Range and kernel. Function of complex variables and their analyticity, Elementary functions, Integration, Taylor and Laurent series expansions, Calculus of residues and its applications.

3. Text Books:

- (i) Linear Algebra with applications by G. Williams, 9th Edition, Jones & Bartlett Learning.
- (ii) Complex Variables and Applications by R.V. Churchill and J.W. Brown, 8th Edition, McGraw-Hill Education.

4. Reference Books:

- (i) Elementary Linear Algebra by Stephen Andrilli and David Hecker, 4th Edition, Elsevier
- (ii) Elementary Linear Algebra, Applications version by H. Anton and C. Rorres, 10th Edition, John Wiley.
- (iii) A First Course in Complex Analysis with Applications by Dennis G. Zill & Patrick Shanahan, 2nd Edition, 2009, Jones & Bartlett.



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5. Course Plan:

| Lec. No. | Learning Objectives | Topics to be covered | Chapter in the Text Book |
|--|---|--|-----------------------------------|
| A. LINEAR ALGEBRA (Text Book (i)) | | | |
| 1 | Introduction to the Course and introduction to system of linear equations | Elementary row operations and Echelon form | 1.1 |
| 2-3 | Inverse of a matrix, Solving system of linear equations and computing Eigenvalues and Eigenvectors | Solutions of linear systems of equations by Gauss Elimination, Gauss-Jordan method. RREF, Eigenvalues and Eigenvectors | 1.1-1.2 2.4,3.4 |
| 4-12 | Introduction to abstract vector spaces, finite and infinite dimensional vector spaces and related concepts. | Vectors in \mathbb{R}^n , linear combination, linear independence, Vector spaces, *Examples of unusual Vector spaces, subspaces, basis and dimension, **Shrinking a linearly dependent set to a Basis, **Extending a linearly independent set to a Basis, Rank of a matrix | 4.1-4.5 *R1 : 4.1 **R1: 4.6 |
| 13-14 | Understanding the change of basis | Coordinate vectors and change of Basis | 5.1 |
| 15-17 | Introduction to linear transformations, examples of linear transformations.. | Linear transformations, kernel and range of linear transformation, Isomorphism, Some matrix transformations | 4.8- 4.10 2.5, 2.6 |
| 18-19 | Understanding the link between linear transformations and matrices. | Matrix of a Linear Transformation | 5.2 |
| B. COMPLEX VARIABLES (Text Book (ii)) | | | |
| | Revision of complex numbers and their properties. | Review (Self Study) | 1-9 |
| 20-21 | Introduction to functions of a complex variable. Evaluation of limits in complex plane. Testing continuity of complex valued functions. | Functions of a complex variable. Limit and continuity | 10-12, 15-18 |
| 22-25 | Introduction to analytic functions. Singular points of a complex valued | Derivative, CR-equations, analytic functions, Harmonic | 19-26 |





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| | function. | functions | |
| 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, hyperbolic and Logarithmic functions, complex exponents, inverse functions. | 29-36 |
| 30-31 | Integrating along a curve in complex plane. | Contour integrals, anti-derivatives. | 37-44 |
| 32-33 | Techniques to find integrals of different functions over particular contours. | Cauchy-Goursat Theorem, Cauchy Integral Formula, Morera's Theorem, Liouville's Theorem. | 46,48-52 |
| | Application of complex variable theory in Abstract Algebra. | Fundamental Theorem of Algebra (Self Study) | 53 |
| 34-35 | Series expansion of a complex function, To study different types of singular points. | Taylor Series and Laurent series. | 57,59, 60,62 |
| 36-38 | Calculating residues at isolated singular points. | Residues, Residue Theorem. | 68-76 |
| 39-40 | Application of complex integration to evaluate improper real integral. | Improper real integrals. | 78-79 |

6. Evaluation Scheme:

| EC No. | Evaluation Component | Duration | Weightage (%) | Date | Nature of Component |
|--------|-------------------------|-----------------------|---------------|-------------------------|---------------------|
| 1. | Assignment I | To be announced later | 10 | To be announced later | Open Book |
| 2. | Mid Semester Exam | 90 min. | 30 | 11/03 - 11.00 - 12.30PM | Closed Book |
| 3. | Assignment II | To be announced later | 10 | To be announced later | Open Book |
| 4. | Classroom Participation | To be announced later | 10 | To be announced later | Open Book |
| 5. | Comprehensive Exam | 180 min. | 40 | 06/05 AN | Closed Book |

7. Notices: All notices about the course will be displayed on CMS.

8. Chamber Consultation Hour: To be announced in the class by the respective Instructors.

9. Make-up Policy: Prior permission is needed for makeup; makeup will be given only for genuine cases.

10. Total marks: 300

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.



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Instructor-In-Charge
MATH F112



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