



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-2021
Course Handout (Part-II)

Date: 10 March 2021

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 : JITENDER KUMAR

Instructors : Amol Holkundkar, Ashish Tiwari, Balram Dubey, Bhupendra Kumar Sharma, Devendra Kumar, Gaurav Dwivedi, Krishnendra Shekhawat, Sangita Yadav, Sandipan Dutta, Santhosh Kumar Pamula, Sourav Kumar Sasmal, Trilok Mathur.

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, Vector spaces, Basis and dimension of vector spaces, Linear transformations, Range and kernel, Eigenvalues and eigenvectors. 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) Elementary Linear Algebra with Supplemental Applications by H. Anton and Chris Rorres, 11th Edition, 2014, John Wiley & Sons.
- (ii) Complex Variables and Applications by R.V. Churchill and J.W. Brown, 8th Edition, 2014, McGraw-Hill.

4. Reference Books:

- (i) Elementary Linear Algebra by S. Andrilli and D. Hecker, 4th Edition, 2012, Elsevier.
- (ii) Introductory Linear Algebra: An Applied First Course by Bernard Kolman and David R. Hill, 9th Edition, 2014, Prentice Hall.
- (iii) Introduction to Linear Algebra with applications by J. Defranza and D. Gagliardi, 2012, McGraw-Hill Education.
- (iv) A First Course in Complex Analysis with Applications by Dennis G. Zill & Patrick Shanahan, 2nd Edition, 2009, Jones & Bartlett.
- (v) Complex Variables with Applications by A. D. Wunsch, 3rd Edition, 2004, Pearson Education



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5. Course Plan:

Module No.	Lecture Sessions	References	Learning outcome
A. LINEAR ALGEBRA (Text Book (i))			
1 System of linear equations and elementary row operations on matrices	L1-L4 Introduction to Systems of Linear Equations, Gaussian Elimination, Elementary Matrices and finding inverse of a matrix using elementary row operations	1.1, 1.2, 1.5, 1.6	Solving system of linear equations and finding inverse of a matrix using row operations
2 Concepts of real vector spaces and subspaces	L5-L8 Real Vector Spaces, Subspaces, Linear Independence	4.1 - 4.3	Introduction to abstract vector spaces, finite dimensional vector spaces and related concepts.
3 Concepts of basis, dimension and rank of a matrix	L9-L12 Basis, Dimension, Row Space, Column Space, and Null Space, Rank, Nullity of a matrix	4.4 - 4.5, 4.7 - 4.8	Finding minimal subset of a vector space to generate the complete vector space.
4 Linear Transformation and properties	L13-L15 General Linear Transformations, Dimension theorem for linear transformations, Isomorphism	8.1 - 8.3	Students will be able to understand basic properties of linear transformations and to check whether the transformation is invertible or not.
5 Coordinate representation and applications	L16-L17 Coordinates, Change of Basis, Matrices for General Linear Transformations	4.4, 4.6, 8.4	Applying coordinate representation to compute matrix of a linear transformation
6 Eigenvalues and eigenvectors	L18 Eigenvalues and eigenvectors.	5.1	Computing eigenvalues and eigenvectors.
B. COMPLEX ANALYSIS (Text Book (ii))			
7 To revise the basic concepts of complex numbers	L19- L20: Review	1 - 11	Quick revision of complex numbers and their properties.
8 To introduce continuity and analyticity of functions of a complex variable	L21 Functions of a complex variable. Limit and continuity	12, 15 -18	Students will be able to evaluate the limits and continuity of functions in complex plane.
	L22-L24 Derivative, CR-equations, analytic functions, harmonic functions	19 - 26	Students will be able to check the analyticity of a complex valued function.
9 To introduce elementary functions in	L25-L28 Exponential, trigonometric and hyperbolic functions. Logarithmic	29 - 36	The present module develops an understanding of basic elementary functions, multiple





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complex variables	functions, Complex exponents, <u>inverse functions</u> (<u>self study</u>)		valued function, branch cut and branch point
10 To introduce complex integration	L29-L30 Contour integrals, anti-derivatives	37 - 44	Integration along a curve in complex plane.
11 Contour Integration and Applications	L31-L32 Cauchy-Goursat Theorem, Cauchy Integral Formula, Morera's Theorem, Cauchy's Inequality	46, 48 - 52	Students will be able to understand techniques to find integrals of different functions over particular contours.
	L33 Liouville's Theorem, Fundamental Theorem of Algebra	53	Application of complex variable theory in Abstract Algebra.
12 To introduce series expansion, residues and applications	L34 Taylor series, Laurent series	60, 62	The present module develops an understanding of series expansion of a function analytic in an annular domain and different types of singular points.
	L35-L36 Poles, Residues, Residue Theorem, zeros	68 - 76	Calculating residues at isolated singular points.
13 Computing improper real integrals	L37 Improper real integrals, <u>Definite integrals involving sines and cosines</u> (<u>self study</u>)	78-81, 85	Application of complex integration to evaluate improper real integral.

6. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date	Nature of Component
1.	Mid Semester Exam	90 min.	30		Closed/Open Book
2.	Quizzes (Two)	45 min. each	30	Announced	Closed/Open Book
3.	Comprehensive Exam	120 min.	40		Closed/ Open Book

7. Chamber Consultation Hours (CCH): To be announced in the respective tutorial class by the respective instructor and Google meet link will be shared for the same. **Before to join google meet for CCH, students are advised to inform well in advance to the respective instructor through mail.**

8. Notices: All notices in relation to the above course will be put up on NALANDA/ Google Classroom.



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9. Make-up policy: Makeup for the evaluation components will be given to genuine cases with prior permission only.

Jitender Kumar
Instructor-In-Charge
MATH F112



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