ARSD College, University of Delhi

Lesson Plan

Course Name : B.Sc. (H) Physics						
Semester	Paper Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
IV	32221401	CC-VIII:: Mathematical Physics III (Theory)	4	0	0	4
Teacher/Instructor(s)		Dr. Ashutosh Vishwa Bandhu				
Session		2021-22				

Course Objective:

- The emphasis of the course is on applications in solving problems of interest to physicists
- Students will be examined on the basis of problems, seen and unseen.
- The course will develop understanding of the basic concepts underlying complex analysis and complex integration and enable student to use Fourier and Laplace Transform to solve real world problems

Course Learning Outcomes:

After completing this course, student will be able to

- Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.
- Work with multi-valued functions (logarithmic, complex power, inverse trigonometric function) and determine branches of these functions
- Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula.
- Find the Taylor series of a function and determine its radius of convergence.
- Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.
- Understand the properties of Fourier and Laplace transforms and use these to solve boundary value problems.

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Lesson Plan:

Unit No.	Unit Heading	Lecture No.	Topics to be covered
Unit 1	Complex Analysis (30L)	1	Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula
		2-5	De-Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables
		6-8	Analyticity and Cauchy-Riemann Equations
		9-15	Examples of analytic functions. Singularities: poles, removable singularity, essential singularity, branch points, branch cut
		16-18	Integration of a function of a complex variable
		19-20	Cauchy-Goursat Theorem, Cauchy's Inequality.
		21-23	Cauchy's Integral formula, Simply and multiply connected region.
		24-26	Laurent and Taylor's expansion.
		27-28	Residues and Residue Theorem.
		29-30	Application of Contour Integration in solving Definite Integrals.
Unit 2	Fourier Transforms (12L)	31-33	Fourier Integral theorem (Statement only). Fourier Transform (FT). Examples: FT of single pulse, trigonometric, exponential and Gaussian functions.
		34-36	FT of derivatives, Inverse FT, Convolution theorem.
		37-38	Properties of FT s (translation, change of scale, complex conjugation, etc)
		39-40	Solution of one dimensional Wave Equation using FT.
		41-42	Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT).
Unit 3	Laplace Transforms(15L)	43-44	Laplace Transform (LT) of Elementary functions.
		45-47	Properties of LTs: Change of Scale Theorem, Shifting Theorem.
		48-49	LTs of 1st and 2nd order Derivatives and Integrals of Functions,
		50-51	Derivatives and Integrals of LTs.
		52	LT of Unit Step function, Periodic Functions.
		53-54	Convolution Theorem. Inverse LT.
		55-56	Application of Laplace Transforms to 2nd order Differential Equations, Coupled differential equations of 1st order
		57	Solution of 1-D heat equation (semi-infinite bar) using LT

Unit 4	**Dirac delta function(3L)**	58	Definition and properties. Representation of Dirac delta function as a Fourier Integral.
		59-60	Laplace and Fourier Transform of Dirac delta function

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment Class Test Attendance Assignment		25
2.	End Semester Examination	3 hr	75

Suggested Books:

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., Cambridge University Press	2006
2.	Complex Variables and Applications, J.W.Brown& R.V.Churchill, 7th Ed. Tata McGraw-Hill.	2003
3.	Complex Variables: Schaum's Outline, McGraw Hill Education	2009
Mode of Evaluation:	Internal Assessment / End Semester Exam	