CURRICULAM PLAN OF Ms. VARSHA

FOR ODD SEMESTER 2023-24

B.Sc (H) DSC -2nd YEAR

PAPER-Mathematical Physics-III (3 PERIODS/WEEK)

LEARNING OBJECTIVES

The emphasis of course is on applications in solving problems of interest to physicists. The course will also expose students to fundamental computational physics skills enabling them to solve a wide range of physics problems. The skills developed during course will prepare them not only for doing fundamental and applied research but also for a wide variety of careers.

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 parameterization, 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 transforms and use these to solve boundary value problems.
- Solve linear partial differential equations of second order with separation of variable method.

CONTENTS	ALLOCATION OF LECTURES	MONTH WISE SCHEDULE FOLLOWED	TUTORIAL/ASSIGNMENT/PRESENTATION ETC
Unit – II Fourier Transform: Fourier Integral theorem (Statement only), Fourier	**10 Lectures**	18th August-30th August 1st September – 30th September	Syllabus Overview Reference books Building concepts Problem solving Derivations and Numericals

Transform (FT) and Inverse FT, existence of FT, FT of single pulse, finite sine train, trigonometric, exponential, Gaussian functions, properties of FT, FT of Dirac delta function, sine and cosine function, convolution theorem. Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT), Solution of one dimensional Wave Equation using FT. **Unit – III Partial Differential Equations:** Solutions to partial differential equations (2 or 3 independent variables) using separation of variables: Laplace's Equation in problems of rectangular geometry. Solution of wave equation for vibrational modes of a stretched string.	**8 Lectures**		
Unit – III Solution of	**2 Lectures**	1st week of October- 4th	Related Problems and assignments Student's difficulties

1D heat flow equation. (Wave/Heat equation not to be derived). **Unit – I** **Complex Analysis:** The field of complex numbers. Graphical, Cartesian and polar representation. Algebra in the complex plane. Triangle inequality. Roots of complex numbers. Regions in the complex plane – idea of open sets, closed sets, connected sets, bounded sets and domain.		week of October	
The complex functions and mappings. Limits of complex functions. Extended complex plane and limits involving the point at infinity. Continuity and differentiability of a complex function, Cauchy-Riemann equations in Cartesian and polar coordinates,	**6 Lectures**	1st November – 30th November	Derivations and Numericals Class test on unit end Discussion of Important questions Home Register Checking Class Test Revision Session Assignment given for IA Home exam paper discussion

sufficient conditions for differentiability, harmonic functions. Analytic functions, singular points. Elementary functions. Multi-functions, branch cuts and branch points. Integration in complex plane: contours and contour integrals, Cauchy-Goursat Theorem (No proof) for simply and multiply connected domains. Cauchy's Inequality. Cauchy's Integral formula. Taylor‟s and Laurent‟s theorems (statements only), types of singularities, meromorphic functions, residues and Cauchy‟s residue theorem, and application of contour integration in solving real integrals.			

Application of contour integration in solving real integrals.	**1 Lecture**	1st week of December	Discussion of last year papers and clarification of doubts Revision of Syllabus Home register Checking

References:

Essential Readings:

1) Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.

2) Essential Mathematical Methods, K. F. Riley and M. P. Hobson, 2011, Cambridge Univ. Press.

3) Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 7 Ed., 2013, Elsevier.

4) Complex Variables and Applications, J. W. Brown and R. V. Churchill, 9th Ed. 2021, Tata McGraw-Hill.

5) Complex Variables: Schaum‟s Outline, McGraw Hill Education (2009).

6) Fourier Analysis: With Applications to Boundary Value Problems, Murray Spiegel, 2017, McGraw Hill Education.

7) A Student's Guide to Laplace Transforms, Daniel Fleisch, Cambridge University Press; New edition (2022).

8) Laplace Transform: Schaum‟s Outline, M.R. Spiegel, McGraw Hill Education

Additional Readings:

1) Mathematical Physics with Applications, Problems and Solutions, V. Balakrishnan, Ane Books (2017).

2) Complex Variables, A.S.Fokas and M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press.

3) Fourier Transform and its Applications, third edition, Ronald New Bold Bracewell, McGraw Hill (2000).

4) Students Guide to Fourier Transforms: With applications In Physics and Engineering, 3rd edition, Cambridge University Press (2015).

5) Partial Differential Equations for Scientists and Engineers, S.J. Farlow, Dover Publications (1993).

6) Differential Equations – Theory, Technique and practice, George F. Simmons and Steven G. Krantz, Indian Edition McGraw Hill Education Pvt. Ltd (2014).