**CURRICULUM PLAN OF Ms. VARSHA**

**FOR ODD SEMESTER 2024-25**

**B.Sc (H) Physics -2nd YEAR**

**PAPER- (DSC) 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.

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| CONTENTS | ALLOCATIO N OF  LECTURES | MONTH WISE SCHEDULE  FOLLOWE D | TUTORIAL/ASSIGNMENT/PRESENTATIO N ETC |
| **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. Solution of  1D heat flow equation. (Wave/Heat equation not to be derived). | **10** LECTURES | 1st Aug. – 30th Aug 2024 | Syllabus Overview  Reference books  Building concepts  Problem solving Derivations and Numericals |
| **Unit – II**  Fourier Transform: Fourier Integral theorem (Statement only), Fourier 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 - I**  Complex Analysis: The field of complex numbers. Graphical, Cartesian and polar  representation. Algebra in the complex plane. | **10** LECTURES | 1st Sept. – 30th Sept. 2024 | Related Problems and assignments  Student’s difficulties  Derivations and Numericals  Class test on unit end |
| Triangle inequality. Roots of complex  numbers. Regions in the complex plane – idea of open sets, closed sets, connected sets,  bounded sets and domain.  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, 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, | 12 lectures | 1st Oct – 30th Oct. 2024 | Discussion of Important questions  Home  Register Checking  Class Test Revision Session  Assignment given for IA  Home exam paper discussion |
| 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, application of contour  integration in solving real integrals. | 12 lectures | 1st Nov. – 27th Nov. 2024 | 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 pplications 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).