Mathematical Physics

1.1. Course Number: PY211

1.2. Contact Hours: 2-1-0 Credits: 8

1.3. Semester Offered: 2nd Year-Even

1.4. Prerequisite: First year UG course on Calculus and Differential Equations

1.5. Syllabus Committee Members: Dr. A. Shukla, Dr. Atul Sharma, Dr. V. Amoli, Dr. J. Karthikeyan, Dr. Tathamay Basu

2. Objective: This course is designed to make students familiar with the popular mathematical tools in physics to deal with complex problems and applications in the areas of Geoengineering. Starting with vector analysis and matrices, the course lays the foundation for advanced mathematical tools like tensors, Fourier series, special functions and partial differential equations which are of uttermost significance in all the areas of Engineering & technology.

3. **Course Content:** Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topics	Lectures
1	Dirac Delta Function and Green Function	Dirac Delta Function properties and its applications, Concept and calculation of Green's function, properties and its application, Approximate Green's function, Green's function method for differential equations	7
2.	Fourier Series	Fourier Series: Dirichlet's Theorem and conditions; Half range series (0 to π); Change of Interval form (-π, π) to (-l to l), Fourier Series in the Interval (0, T), Change of Interval (0, T) to (0, 2l), Application of Fourier series.	7
3	Fourier Transforms	Fourier's Transform and its Properties; Fourier Transform of a Derivate; Fourier sine and cosine Transforms of Derivatives; Finite Fourier Transforms, Applications of Fourier Transformations	7
4.	Laplace Transforms	Laplace Transform and its properties; Laplace Transform of Integral, Periodic functions and some Special Functions; Inverse Laplace Theorem; Properties of Inverse Laplace Transform; Application of Laplace Transform	7
		Total	**28**

4. Readings:

4.1. Textbook:

- Mathematical Methods for Physicists by ARFKEN & WEBER.
- Mathematical Physics by H. K. Dass (S. Chand Limited, 2008)
- Fourier Series, Fourier Transform and Their Applications to Mathematical Physics by Valery Serov.
- Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley.

4.2. Reference Books:

- Mathematical Methods of Physics; Mathews-Walker
- Mathematical Physics: A modern introduction to its foundations; Sadri Hassani
- A Guided Tour of Mathematical Physics by Roel Snieder, Cambridge University Press

5. Outcome of the course:

This course is designed in such a way that the students learn the fundamentals of mathematical physics, which will build the base for understating the advanced concepts and solving the theoretical and experimental problems in various streams including Geoengineering and Petroleum. They will be able to apply various mathematical techniques like Vector Operator, Differential Equations, Tensors, Fourier transformations etc. for solving complex theoretical and experimental problems in the areas of geoengineering.