Sankalchand Patel University

Faculty of Science and Humanities

Master of Science (SEM-1)(Physics)

In Effect from Academic Year 2021-22

Subject Code:1SC2050101	**Subject Title:** Mathematical Physics

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- Develop an actual understanding of use of Mathematics in Physics.

Teaching scheme (hours) per week		**Credit**		**University Examination**		**Internal Examination**		**Total**
Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	
4	**--**	**4**	**--**	**60**	**-**	**40**	**---**	**100**

Unit	Content	Lectures	Weight (%)
1	**Linear vector space** - Definition and examples, scalar product, dual vectors and Cauchy-Schwarz inequality, real and complex vector spaces, metric spaces. **Quantum states:** State vectors and wave-functions, The Hilbert space of state vectors, Dynamical variables and linear operators and their algebra. Projection operators. The quantum condition, self-adjointness Special operators such as Hermitian, Unitary etc. and their properties, Eigenvalues and eigenvectors, Expansion of identity, linear independence of vectors, generalized Eigen vectors, orthogonalization.	15	25
2	**Tensors:** Types of tensors and their algebra, Contraction and inner product, Metric tensors, Quotient rule, Dual and irreducible tensors, Christoffel symbols, covariant derivative, Geodesic equation. **Introduction to group theory:** Definition and examples, group multiplication table, homomorphism and isomorphism, matrix representations – reducible and irreducible, classes and character, subgroups and cosets, Dihedral group, orthogonal groups and special unitary group, Illustrations of the group concept in various branches of physics.	15	25
3	Introduction, Analytic functions, Contour integrals, Laurent series, The Residue theorem, Methods of finding residues ,Evaluation of definite integrals by use of the residue theorem, The Point at infinity; residues at infinity, Mapping. Green's function – definition, Three methods of constructing Green's function, Few examples.	15	25
4	Integral transforms, Fourier transform and its properties as well as applications such as Gaussian function, finite wave train, etc., Convolution theorem, momentum representation, Laplace transform and its properties, Laplace transforms of some elementary functions and derivatives including some applications in the problems of physics e. g. step function, simple harmonic oscillator, damped oscillator- RLC analogy etc.	15	25

Basic Reference book:

1. Mathematical Methods for Physicists by G. Arfkenand Weber, Academic Press, 6th Ed (2005).

2. A text book of Quantum Mechanics, by Mathews &Venkatesan, TMH Publication (2010)

3. Mathematical Physics by P. K. Chattopadhyay (Wiley Eastern Limited, (1990).

4. Vector Analysis Murray Spiegel (Schuam Series).

5. Mathematical Methods in Physical Sciences by M. L. Boas, Second Edition, John Wiley & Sons, (1996).

6. Mathematical Methods of Physics by Mathews & Walker, 2nd Ed. 2004 Pearson Education, (Singapore) Indian Br. Delhi, India.

7. Elements of Group Theory for Physicists by A W Joshi, New Age Int. Pub, New Delhi (1997).

8. Matrices and Tensors in Physics by A W Joshi 3rd Ed., New Age International (P) Ltd. New Delhi.