PGP / PSP 4436 **MATHEMATICAL PHYSICS - II** **4 hrs / 4 Cr**

This Course introduce linear vector, matrices, Tensors, probability and group theory by exploring mathematical behaviour in physics. Students familiarize themselves with the importance and uniqueness of mathematical tools to analyse physics phenomenon.

At the end of the course, students will be able to

i. explain the properties of linear vector space and matrices and apply them to analyze a broad range of physical models
ii. apply the concepts of Tensor analysis and Tensor calculus to formulate physical laws and simplify them using coordinate transformations
iii. apply probability and statistical laws to physical problems
iv. explain basic concepts in group theory and its importance in physics
v. usecharacter table and group symmetry to form irreducible representations

Unit I: Linear Vector Space and Matrix Analysis

Definition of a linear vector space – Linear independence, basis – Scalar product – Orthonormal basis – Gram-Schmidt orthogonalization process – Linear operators. Special matrices – Eigen values and Eigen vectors – Cayley Hamilton theorem – Coordinate transformations.

Unit II: Tensors Analysis

Introduction – Transformation of Coordinates – Contravariant and Covariant tensors - Algebra of tensors – Quotient law – The line element – Fundamental metric tensor – Associate tensors.

Unit III: Tensors Calculus and Probability

Christoffel symbols – Covariant differentiation of tensors – Equation of the Geodesic line – Riemann-Christoffel tensors. Elementary probability theorem – random variables – Binomial, Poisson and Normal distributions

Unit IV: Abstract Group Theory

Definition and nomenclature – multiplication table – Rearrangement theorem – Cycle groups – Sub-groups – Cosets, class – Normal divisors and factor groups – Class multiplication - Continuous groups – SU(2) and SU(3) – Orthogonal.

Unit V: Theory of Group Representation

Reducible and irreducible representation – Great orthogononality theorem (no proof) – Character representation – Character table decomposition of reducible representation – Regular representation – Application of representation theory

Text Books:

1. P.K.Chattopadhyay, *Mathematical Physics*, New Age International Publishers (2013).
2. Charlie Harper, *Introduction to Mathematical Physics*, Prentice-Hall, Inc (1976),
3. Louis A. Pipes and Lawrence R. Harvill,*Applied Mathematics for Engineers and Physicists*, McGraw-Hill, International Third Edition (1970)
4. A.W.Joshi, *Elements of group theory for physicists*, New Age International Publishers (1997),