BSP 401 Elements of Mathematical Physics

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Internal	Term Work	Practical/Viva	Total Marks
					MS	ES				
4	0	0	4	4	25	50	25	--	---	100

Course Objective:

1. To understand the concept of linear vector spaces.
2. To comprehend the concepts of matrices to solve system of linear equations.
3. To establish knowledge of partial differential equations.
4. To enable students to understand and solve the problems of heat flow and membrane waves using partial differential equations.

UNIT I Linear Vector Spaces (15Lectures)

Abstract Systems. Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

UNIT II Matrices (15 Lectures)

Addition and Multiplication of Matrices. Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. Adjoint of a Matrix. Inverse of a Matrix by Adjoint Method. Similarity Transformations. Orthogonal and Unitary Matrices. Trace of a Matrix. Inner Product.
Eigen-values and Eigenvectors. Cayley- Hamiliton Theorem. Diagonalization of Matrices. Solutions of Coupled Linear Ordinary Differential Equations. Bilinear and Quadratic Forms. Functions of a Matrix.

UNIT III Partial Differential Equations (15 Lectures)

General Solution of Wave Equation in 1 Dimension. Separation of variables, Power series methods (recurrence relations), Transverse Vibrations of Stretched Strings. Oscillations of Hanging Chain. Wave Equation in 2 and 3 Dimensions. Vibrations of Rectangular and Circular Membranes.

UNIT IV Heat Flow Problems (15 Lectures)

Heat Flow in One, Two, and Three Dimensions. Heat Flow in Rectangular Systems of Finite Boundaries. Temperature inside Circular Plate. Laplace Equation in Cartesian, Cylindrical and Spherical Coordinate Systems. Problems of Steady Flow of Heat in Rectangular and Circular Plate.

Total: 60 Hrs

Course Outcome:

On completion of the course, students will

1. Be able to Relate the concepts of vector spaces and linear transformation to the physical problems.
2. Be able to Identify concepts of matrices to solve system of linear equations.
3. Be able to Recognize the problems of partial differential equations.
4. Be able to Solve problems related to heat flow and membrane waves using partial differential equations.
5. Be able to understand separation of variable and power series mathematical methods to solve physics problems.
6. Be able to Identify and Evaluate the heat flow problem in various coordinate systems.

Reference Books:

1. Matrices and Tensors in Physics by A.W.Joshi.(New Age Int.Pub., 1995).
2. Linear Algebra Theory and Applications by Ward Cheney and David Kincaid (Jones & Bartlett)
3. Vector Spaces and Matrices in Physics by M. C. Jain (Alpha Science International Ltd, 2007).
4. Partial Differential Equations for Scientists and Engineers By Stanley J. Farlow (Dover Publishers, 1993).
5. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Limited,1985)
6. A Text Book of Differential Equations By N. M. Kapoor (Pitambar Publishing, 2006).

7. Methods of Mathematical Physics: Partial Differential Equations by R.Courant & D.Hilbert.(New Delhi: Wiley India, 2008).