MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHH 451: MATHEMATICAL PHYSICS II

[52 Hrs.]

Course outcome

CO1 Gain knowledge of tensors and able to apply tensors in the analysis various physical phenomenon.

CO2 Have the knowledge of Fourier series and Fouriertransformations, and its applications.

CO3 Have the knowledge of Green's functions and applications of Green's functions.

CO4 Have the knowledge of group theory and the use of grouptheory in different branches of physics.

Unit I Tensor analysis: Introduction - rank of a tensor. Transformation of coordinates in linear spaces - transformation law for the components of a second rank tensor. Contra-variant and covariant and mixed tensors - First rank tensor, higher rank tensors, symmetric and antisymmetric tensors. Tensor algebra - outer product - contraction - inner product - quotient law. The fundamental metric tensor - associate tensors. Line element and Metric Tensor, Christoffel's Symbols of first and second kind, Length of a vector, Angle between vectors, Geodesics, Covariant derivative, Tensor form of Gradient, Divergence and Curl

[13 hrs]

Unit II Fourier series: Fourier integral and Fourier transform - definition - special form of Fourier integral and properties. Convolution theorem involving Fourier transform. Applications of Fourier transforms. Laplace transform - Convolution theorem involving Laplace transforms. Applications of Laplace transforms. [13 hrs]

Unit III Green's Functions and Integral Equations: Green's function for one, two and three dimensional equations, Eigen function expansion of Green's functions, Fredholm and Volterra type integral equations, solution with separable kernels, Neumann series method. Non-homogeneous integral equations. [13 hrs]

Unit IV Groups - subgroups - classes. Invariant subgroups - factor groups. Homomorphism and Isomorphism. Group representation - reducible and irreducible representation. Schur's lemmas, orthogonality theorem. Decomposing reducible representation into

irreducible ones. Character of a representation, character table, Construction of representations. Representation of groups and quantum mechanics. Lie groups and Lie algebra. Generators of Unitary Groups, Three dimensional rotation group SO(3), SU(2) and SU(3) groups. The homomorphism between SU(2) and SO(3) groups.

[13 hrs]

Text Books:

1. Chattopadhyaya P K, 'Mathematical Physics' (Wiley Eastern, 1990)
2. Joshi A W, 'Introduction to Group Theory' (Wiley Eastern, 1995)
3. Spiegel M R, 'Vector Analysis' (Schaum series, Tata McGraw Hill, 2009)
4. Joshi A W, 'Matrices and Tensors in Physics' (Wiley Eastern, 199
5. Arfken G, 'Methods of Mathematica Physics, (Academic Press 2005)
6. Kreyszig, Advanced Engineering Mathematics, (New Age International, 2004)

Reference Books:

1. Sokolnikoff and Redheffer, 'Mathematics of Physics and Modern Engineering, (McGraw Hill, 1958)
2. Irving J and Mullneu N, 'Mathematics in Physics and Engineering' (Academic Press, 1959)
3. Mary L Boas, 'Mathematical Methods in the Physical Sciences' (John Wiley, 1983)
4. Mathews J and Walker R L, 'Mathematical Methods of Physics' (W A Benjamin, Inc, 1979)
5. Sreenivasa Rao K N, 'The Rotation and Lorentz Groups and Their Representations for Physicists' (John Wiley & sons, 1988)
6. N.Hammermesh,'Group Theory', (Addison-Wesley,1964)
7. M.Tinkham,'Group Theory and Quantum Mechanics', (McGraw-Hill,1964)
8. E.Butkov, 'Mathematical Physics', (Addison-Wesley,1968)
9. P.M.Morse and H.Feshbach,'Methods of Theoretical Physics', (Interscience,1953)