Mathematical Physics II and Quantum Mechanics II

Upon completion of Mathematical Physics II and Quantum Mechanics II, students will be able to:

1. Apply second order homogeneous and inhomogeneous differential equations to solve problems in mathematical physics, including determining Wronskians, finding general solutions, and understanding singularities.
2. Analyze Sturm-Liouville problems, SL operators, and expansions in orthogonal functions using Rodrigues formula and special functions.
3. Utilize integral transforms with an understanding of kernels and their applications in various mathematical physics problems.
4. Solve partial differential equations such as Laplace, Poisson, and Helmholtz equations in physical systems, as well as understand diffusion and wave equations and their applications.
5. Demonstrate a comprehensive understanding of group theory concepts including sets, maps, homomorphism, isomorphism, conjugate elements, and equivalence classes.
6. Apply the definitions and properties of group structures including cyclic groups, permutation groups, and Cayley's theorem in quantum mechanics problems.
7. Analyze group representations, including faithful and unfaithful representations, reducible and irreducible representations, character of a representation, and orthogonality theorems, to solve quantum mechanics problems.
8. Understand Lie groups and Lie algebras such as SU(2) and SU(3) groups, and their corresponding Lie algebras, as well as introduction to Lorentz and Poincare groups in quantum mechanics applications.
9. Apply approximation methods in quantum mechanics, including time-independent perturbation theory, degenerate perturbation theory, and variational methods, to solve physical systems with various potentials and interactions.