What is taught in this course will depend in part on the interests and backgrounds of the students. The intent is to give students a good grounding in analytic, numerical and mixed analytic/numeric techniques of mathematical physics. Likely topics include:

Group Theory
- Finite/Infinite discrete Groups and infinite/continuous (Lie) Groups.
- Group representations and examples
- Application of group theory to evaluation of integrals, matrix elements, and other parts of physics
- Product representations, Wigner-Eckhart Theorem and applications, possibly Clebsch-Gordan coefficients and applications.

Asymptotic analysis
- Asymptotic analysis of sums, integrals and ordinary differential and difference equations
- Analysis of an integral representation of a special function as an example of an asymptotic expansion
- Use of complex analysis to improve analytic and numeric calculations of sums and integrals
- The principle of asymptotic balance, boundary layer theory, asymptotic matching, global asymptotic analysis
- Analysis of asymptotic series, including Pade approximates, two-point Pade’s, Borel resummation.
- Finding accurate approximations to complex functions / integrals simply so they can be evaluated quickly in numerically in “inner loops”
- Multiple time scale analysis

Numerical Techniques for partial differential equations
Transform techniques
- Fast Fourier Transforms and applications
- Convergence of various transform methods for representing functions
- Transform techniques in partial differential equations