PH 405: MATHEMATICAL PHYSICS-II (3-1-0:4)

Complex Analysis
Analytic functions, Cauchy-Riemann equation, classification of singularities, Cauchy's theorem, Taylor and Laurent expansions, analytic continuation, residue theorem, evaluation of definite integrals, summation of series, gamma function, zeta function, method of steepest descent.

Integral Transforms
Fourier and Laplace transform, inverse transforms, convolution theorem. Application of solving ODEs and PDEs by transform methods.

Tensors
Tensors in index notation, Kronecker and Levi Civita tensors, inner and outer products, contraction, symmetric and antisymmetric tensors, quotient law, metric tensors, covariant and contravariant tensors, simple applications to general theory of relativity and Klein-Gordon and Dirac equations in relativistic quantum mechanics.

Group Theory
Basic definitions, Lagrange's theorem, invariant subgroup, homomorphism and isomorphism between groups, representation of a group, unitary representations, Schur's lemmas, orthogonality theorem, character table, simple applications to symmetry groups and molecular vibrations.

Textbooks and References:
1. S. Sokolnikoff, "Tensor Analysis Theory and Applications", John Wiley & Sons.
2. S. Hess, "Tensors for Physics", Springer.
3. J. F. Cornwell "Group Theory in Physics: An Introduction", Academic press.
4. M. R. Spiegel, "Complex Variables", McGraw-Hill Education.
5. A. Zee, "Group Theory in a Nutshell for Physicists", Princeton University Press.
6. G. P. Tolstov and R. A. Silverman, "Fourier Series", Dover Publications Inc.
7. R. J. Beerends, H. G. Ter Morsche, J. C. Van Den Berg, and E. M. Van De Vrie, "Fourier and Laplace Transforms", Cambridge University Press.