This course will survey the key concepts and results from functional analysis that need to be in the tool kit of researchers in quantum information theory. Concepts will be developed but proofs will only be presented as needed.

Graduate students in Pure Mathematics with interests in functional analysis are encouraged to take Functional analysis PMATH 753 and Banach algebras PMATH 810.

Topics to be covered include:

- Basics:
  - Basic facts about normed spaces
  - Finite and infinite dimensional Hilbert spaces
  - Bounded and unbounded operators on Hilbert spaces
  - Classes of operators: self-adjoint, trace class, Hilbert-Schmidt
  - Tensor products of Hilbert spaces
  - Infinite tensor products of Hilbert spaces and quantum spin chains
  - Basic introduction to C*-algebras
  - States and the GNS construction

- Theory of completely positive and completely bounded maps
  - Stinespring’s theorem
  - Choi-Krauss representation via Stinespring
  - Introduction to operator systems and operator spaces
  - CP maps as states on a tensor product
  - Extensions of CP and CB maps
  - Wittstock’s decomposition theorem
  - Applications to PPT maps
  - Topics in the theory of CP and CB maps