1. Curvilinear reference systems; vector operators $\nabla$, $\nabla \cdot$, $\nabla^2$ in polar spherical and cylindrical systems. Quantum-mechanics observable operators: $(L^2, L_z)$. 2 h

   - The method of variable separation (Laplace equation in polar spherical system) 2 h
   - 2nd order linear differential equations (1 variable). The method of Frobenius (power series). Gauss (hypergeometric) equation; confluent equation. Truncated series (Legendre equation). 4 h
   - Applications: Schrödinger equation for hydrogen atom, 1-D quantum harmonic oscillator. 3 h
   - Sturm-Liouville systems. Self-adjoint operators. Eigenfunctions and eigenvalues. Hilbert spaces. Sturm-Liouville system solutions in the orthogonal polynomial class. 4 h
   - Integral transforms (Fourier transform and Laplace transform).
     (a) Definition and properties of Fourier transform. Wave equation. 2 h
     (b) Application to QM QM — momentum representation, time evolution of a wave-packet), charge distribution in a nucleus. 3 h
     (c) Diffusion equation. Simple examples of solution using the separation of variables and Laplace transform techniques. 3 h

3. Green function
   - Non-homogeneous equation; source term. 1 h
   - Dirac delta; definitions, properties. Heaviside function. 2 h
   - 3-D case. Green function for operators: $\Delta i \Delta + k^2$. QM — scattering problems (spherically symmetrical potential, Coulomb potential. Born approximation). 4 h
   - Green function in 1-D case. 2 h