Syllabus 2012-2013 and References.

1. Outline:

1. **Numerical Linear Algebra:** review on minimization and rootfinding of nonlinear algebraic systems, direct methods for linear systems (LU-decomposition, Gauss, pivoting), iterative methods (Jacobi, conjugate gradient methods, GMRES), eigenvalue computation (power method, Arnoldi methods).
2. **Fourier Analysis:** trigonometric interpolation and discrete Fourier transform, generalized Fourier series and polynomials, Gibbs phenomenon, aliasing phenomenon, FFT (Fast Fourier Transform).
3. **Initial value problems:** systems of (nonlinear) ordinary differential equations (multistep linear implicit/explicit formulas, A-stability, Adams, Curtis-Hirschfelder and Runge-Kutta time steppers). Physical applications (computational dynamics of conservative and dissipative systems).
4. **Boundary value problems:** local and global differentiation matrices (finite differences and Chebychev), numerical implementation of Dirichlet and/or Neumann boundary conditions, eigenvalue analysis. Physical applications: computation of spectra (eigenvalues and eigenfunctions) of nonlinear (and quasilinear) classical and quantum nonlinear operators (vibrating membranes and strings, Airy's equation, Schrödinger equation for nontrivial potentials).

2. References:

1. A. Quarteroni, F. Saleri, *Cálculo Científico con MATLAB y Octave*, Springer, 2006.
2. A. Quarteroni, R. Sacco, F. Saleri, *Numerical Mathematics*, Springer, 2007.
3. M. Grau Sánchez, M. Noguera, *Càlcul numèric: Teoria i pràctica*, Edicions UPC, 2000.
4. G. Dahlquist, A. Bjorck, *Numerical Methods in Scientific Computing, vols. I and II*, SIAM, 2008.