Qualifying exam syllabus for NUMERICAL ANALYSIS (MAD 6406-7):

Numerical Linear Algebra (1st Semester, MAD 6406):
1. Matrix ranks, row and column spaces, null and range spaces
2. Vector norms, induced matrix norms, Frobenius norm.
3. Inner and outer products, orthogonality
4. Cauchy-Schwarz and Holder inequalities
5. Complex matrices, adjoints, unitary, Hermitian and positive definite matrices
6. Real matrices, transposes, orthogonal and symmetric matrices
7. Singular value decomposition (SVD)
8. Projectors, complementary and orthogonal projectors
9. QR factorization
10. Least squares problems
11. Conditioning and condition number
12. Floating point arithmetic
13. Stability and backward stability
14. Gaussian elimination, LU factorization and pivoting
15. Cholesky factorization
16. Eigenvalues and eigenvectors – Theory
17. Eigenvalues and eigenvectors – Computation
18. Krylov space methods
19. Preconditioning

Numerical Analysis (2nd semester, MAD 6407):

Iterative algorithms, convergence, contraction mapping theorem, Newton's method. Lagrange and Hermite interpolation problems, error of polynomial interpolation. Weierstrass theorem, Chebyshev equioscillation theorem, minimax and least square polynomial approximation, orthogonal polynomial families. Newton-Cotes and Gaussian quadratures, error estimates.