COURSE OUTLINE – subject to changes:

L-1 Mon 22 Aug 0.1,0.2 welcome to MCS 471, evaluating polynomials, binary numbers
L-2 Wed 24 Aug 0.3,0.4 floating-point numbers and floating-point arithmetic
L-3 Fri 26 Aug 1.1,1.2 bisection, fixed-point iterations, cobweb diagrams
L-4 Mon 29 Aug 1.3 forward and backward error, multiple roots, condition number
L-5 Wed 31 Aug 1.4 Newton’s method, its convergence to single and multiple roots
L-6 Fri 2 Sep 1.5 the secant method, superlinear convergence, regula falsi

Project one is due on Friday 16 September, at 10am.

L-7 Mon 5 Sep Labor Day holiday. No classes.
L-8 Wed 7 Sep 13.1 optimization without derivatives, golden section search
L-9 Fri 9 Sep 2.1,2.2 linear algebra, Gaussian elimination, LU factorization
L-10 Mon 12 Sep 2.3 norms, the condition number of a linear system
L-11 Wed 14 Sep 2.4 row pivoting for numerical stability, PA=LU factorization

Project two is due on Wednesday 5 October, at 10am

L-12 Fri 16 Sep 2.5 iterative methods for linear systems
L-13 Mon 19 Sep 2.6 positive definite matrices, the Cholesky factorization and its cost
L-14 Wed 21 Sep 2.6,2.7 the conjugate gradient method and the multivariate Newton method
L-15 Fri 23 Sep 3.1 polynomial interpolation with Lagrange and Neville
L-16 Mon 26 Sep 3.2 divided differences, the condition of interpolation
L-17 Wed 28 Sep 3.3 Chebyshev interpolation; Padé approximation
L-18 Fri 30 Sep 3.4 cubic splines; Bezier curves
L-19 Mon 3 Oct 4.1,4.2 fitting data; conditioning of the least squares problem

Project three is due on Friday 28 October, at 10am

L-20 Wed 5 Oct 4.3 the QR factorization, modified Gram-Schmidt, Householder reflectors
L-21 Fri 7 Oct 4.4 iterative methods for least squares, Krylov, preconditioned GMRES
L-22 Mon 10 Oct 4.5 nonlinear least squares, Gauss-Newton, Levenberg-Marquardt
L-23 Wed 12 Oct review for the first midterm exam
L-24 Fri 14 Oct the first midterm exam
L-25 Mon 17 Oct 5.1 finite difference formulas; Richardson extrapolation
L-26 Wed 19 Oct 5.2 Newton-Cotes formulas for numerical integration
L-27 Fri 21 Oct 5.3,5.4 adaptive integration; Romberg integration
L-28 Mon 24 Oct 5.5 Gaussian quadrature; orthogonal polynomials
L-29 Wed 26 Oct 6.1,6.2 Euler’s method to solve initial problems; Lipschitz continuity

Project four is due on Monday 14 November, at 10am

L-30 Fri 28 Oct 6.2,6.3 higher order equations; linear systems, spectral decomposition
L-31 Mon 31 Oct 6.4 local and global errors; Runge-Kutta methods
L-32 Wed 2 Nov 6.5,6.6 stability of solutions; stiff equations
L-33 Fri 4 Nov 6.7 predictor-corrector methods; variable step methods
L-34 Mon 7 Nov 7.1 solving boundary value problems with shooting methods
L-35 Wed 9 Nov 7.2 linear, characteristic-value, and nonlinear problems
L-36 Fri 11 Nov 7.3 collocation and the finite element method

Project five is due on Wednesday 30 November, at 10am

L-37 Mon 14 Nov review for the second midterm exam
L-38 Wed 16 Nov the second midterm exam
L-39 Fri 18 Nov 8.1 parabolic PDEs, finite differences for the heat equation
L-40 Mon 21 Nov 8.2 hyperbolic PDEs, finite differences for the wave equation
L-41 Wed 23 Nov 8.3 elliptic PDEs, finite differences for steady state equations

Fri 25 Nov Thanksgiving holiday. No classes.
L-42 Mon 28 Nov review of the materials before the first midterm exam

Project five is due on Wednesday 30 November, at 10am

L-43 Fri 2 Dec review of the materials between the two midterm exams

comprehensive review

Final exam: in the week from Monday 5 to Friday 9 December, TBA.