II Civil Engineering
NUMERICAL ANALYSIS
Academic year 2008-2009

Exam Questions – January-February 2009

Item No.	*Chapter [– Sub-Chapter]:* Topic[†]
1	*Object of Numerical Analysis:* Object. Problem conditioning, condition number. Algorithm stability. Conclusions regarding problem conditioning and algorithm stability.
2	*Computer representation of numbers:* Integers. Reals, floating-point representation: Representation models (scientific; binary computer).
3	*Computer representation of numbers:* Reals, floating-point representation: Format structure; IEEE Formats.
4	*Computer representation of numbers –IEEE Formats:* Special values; Representation range.
5	*Computer representation of numbers – Rounding error measure:* ULP; machine-ε; Unit rounding error.
6	*Errors, sources and propagation:* Error; Relative error; Significant digits; Relationship with the relative error.
7	*Errors, sources and propagation:* Error sources. Rounding error; Truncation case. Examples for base $\beta = 2$.
8	*Errors, sources and propagation – Error propagation:* Propagated error. Multiplication; Division; Function evaluation.
9	*Errors, sources and propagation – Error propagation:* Loss of signification error. Addition and subtraction. Propagation of errors in a sum.
10	*Nonlinear equations:* Method and method analysis; Order of convergence. Linear convergence.
11	*Roots of an equation f(x) = 0:* Bisection method. Secant method. Remarks on secant method.
13	*Roots of an equation f(x) = 0 – Newton method:* Method; Convergence.
14	*Roots of an equation f(x) = 0 – Newton method:* Error estimation. Comparison with Secant method.
15	*Fixed-Point method:* Fixed-point theorems. Geometrical interpretation.
16	*Fixed-Point method:* Fixed-point methods of order higher than 1; Application: Newton method.
17	*Fixed-Point method – Implementation:* Error evaluation. Algorithm: test for stopping the iteration. The stationary process.
18	*Fixed-Point method:* Explicit fixed-point procedures; Examples: Iteration with constant $\Phi(x) = m$ (chord method); Newton method.

Item No.	*Chapter [– Sub-Chapter]:* Topic[†]
19	*Multiple roots of equation f(x) = 0:* Problems; Newton method and Modified Newton method; Determination of order of multiplicity.
20	*Root of a polynomial:* Polynomial evaluation; Deflation; Newton method for polynomials.
21	*Root of a polynomial:* Method algorithm: Computation of coefficients b_k, c_k . The algorithm with deflation; Direct iteration in the original polynomial.
22	*Root of a polynomial:* Stability of the roots. Examples. Complex roots (elements).
23	*Systems of non-linear equations:* Definitions. Vector norm. Matrix norm; spectral radius.
24	*Systems of non-linear equations:* Fixed-point method. Convergence. Second order convergence. Practical iteration scheme.
25	*Systems of non-linear equations – Fixed-Point method:* Explicit fixed-point procedure; Iteration with constant matrix **A** (updated).
26	*Systems of non-linear equations:* Newton Method; Convergence; Practical iteration scheme.
27	*Systems of non-linear equations – Newton method:* Numerical evaluation of partial derivatives. Newton-like methods.
28	*Linear systems of equations:* General considerations. Gauss elimination. Triangular factorization of system matrix; determinant evaluation. Pivoting in Gauss elimination.
29	*Linear systems of equations – Gauss elimination:* Number of operations in Gauss elimination; Comparison with other processes. Matrix inversion, number of operations.
30	*Linear systems of equations:* LU decomposition; Solution steps; Number of operations. Direct evaluation of LU factors, methods.
31	*Linear systems of equations – Cholesky method:* Symmetric and positive definite matrices: definition, properties. Cholesky method, number of operations.
32	*Linear systems of equations – Solution stability and error analysis:* Perturbation in **b** (RHS); Number of condition of a matrix: definition, properties. Well- and ill-conditioned matrices. Examples.

[†] *Chapter/Sub-chapter* and Topic refer to course lectures.

January 20, 2009

Adrian Chisăliţă