Numerical Analysis - Web course

COURSE OUTLINE

1. Errors Analysis.
2. System of Linear Equations.
3. Eigen values and Eigen vectors
4. Roots of Non-linear Equations.
5. Finite Differences and Divided Differences.
6. Interpolation.
7. Numerical Differentiation.
8. Numerical Integration.
9. Numerical Solution of ODE.

COURSE DETAIL

Module	Topics and Contents	Lectures
1	**Error Analysis** Types of errors, Propagation of errors, Correct and Significant digits, Examples and exercises.	3
2	**Solution of System of Linear Equations** Exact methods: LU-decomposition, Gauss-elimination methods without and with partial pivoting. Iterative methods: Gauss-Jacobi and Gauss-Seidal methods, Matrix norm, Condition number and Ill-conditioning, Examples and Exercises.	4
3	**Eigen values and Eigen vectors** Largest and Smallest eigen values and eigen vectors by power method, Examples and Exercises.	8
4	**Roots of Non-linear Equations** Bisection, Regula Falsi, Newton–Raphson methods, Direct Iterative method with convergence criterion, Extension of Newton-Raphson and Iterative methods for two variables, Examples and Exercises.	7
5	**Finite Differences and Divided Differences**	4

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Mathematics

Additional Reading:

- Kendall E. Atkinson, An Introduction to Numerical Analysis, Wiley; 2 edition, (January 17, 1989), ISBN-10: 0471624896 , ISBN-13: 978-0471624899.
- S.S. Sastry, Introductory Methods Of Numerical Analysis, Prentice Hall of India Pvt. Ltd. (2007), ISBN-13: 978-8120327610.
- B.S. Grewal, Numerical Methods In Engineering & Science With Programs In Fortran 77, C & C++, Khanna Publishers (2008), ISBN-13: 978-8174091468.

Hyperlinks:

- http://web.comlab.ox.ac.uk/teaching/courses/na/
- http://www.math.upenn.edu/~wilf/DeturckWilf.pdf
- http://www.maths.manchester.ac.uk/~cp/frontpage157.htm
- http://www.math.umn.edu/~olver/num_/lna.pdf

Coordinators:

Dr. Sandip Banerjee
Department of MathematicsIIT Roorkee

Prof. Roshan Lal
Department of MathematicsIIT Roorkee

	Operators, Difference table, Propagation of errors, Divided differences with properties, Examples and Exercises.	
6	**Interpolation** Interpolation Formulae: Newton's forward, backward, Stirling's and Bessel's formulae, Newton's divided difference and Lagrange's formulae, Errors in various interpolation formulae. Inverse Interpolation: Successive approximation and Lagrange's method, Examples and Exercises.	4
7	**Numerical Differentiation** Various formulae for first and second derivative with errors, Examples and Exercises.	4
8	**Numerical Integration** Newton-Cotes formulae, General quadrature formula for equidistant ordinates, Trapezoidal, Simpson's 1/3 and 3/8 rules with their geometrical interpretations and errors, Romberg integration and Gaussian quadrature formulae, Examples and Exercises.	4
9	**Numerical solution of ODE** Picard, Taylor series, Modified-Euler, Fourth order Runge-Kutta methods with errors, Examples and Exercises.	5

References:

- James Scarborough, Numerical Mathematical Analysis, Oxford & IBH Publishing Co. Pvt. Ltd (1950), ISBN 10: 0009780021, ISBN-13:978-0009780021.
- M. K. Jain, SRK Iyengar and R.K. Jain, Numerical Methods For Scientific & Engg 5e, New Age International (P) Ltd (2008), ISBN-13:978-8122420012.
- C.F. Gerald and O.P. Wheatley, Applied Numerical Analysis, Addison Wesley; 7 edition (2003) , ISBN-13:978-0321133045.