Numerical Solution of ODEs - Web course

COURSE OUTLINE

ODEs: Single step methods, Multistep methods, and Hybrid methods for initial value problems(Stiff and Non-stiff) with consistency, stability, convergence and weak stability of these methods.
Finite difference methods for boundary value problems for second order differential equations

COURSE DETAIL

Modules	Topics and Contents	Number of Lectures
1. Introduction	1. Preliminaries 2. Existence, Uniqueness, and Wellposedness 3. Stability and Asymptotic Stability	3
2. Single Step Methods	4. The Euler Method 5. Convergence of Euler's Method 6. Improvement of the error bound 7. Stability	4
3. Higher order Single Step Methods	8. Higher Order Methods 9. Runge-Kutta Methods 10. Error bounds for Runge-Kutta methods 11. Absolute Stability for Runge-	4

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Mathematics

Pre-requisites:

Basic course in Numerical analysis

Coordinators:

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	Kutta Methods	
4. Systems of Equations and Equations of Order Greater Than One	12. Systems of Equations 13. Direct Methods For Higher Order Equations	2
5. Consistency, Stability and Convergence of General Single – Step Methods	14. General Single Step Methods 15. Convergence of General One-Step Methods	2
6. Implicit Runge-Kutta Methods	16. Derivation of Implicit Runge-Kutta methods 17. Derivation of Implicit Runge-Kutta Methods(Contd.)	2
7. Multistep Methods	18. Multistep Methods 19. Multistep Methods (Contd.) 20. Multistep Methods(Contd.) 21. The local error of the formulas based on integration 22. Local Error of Nystrom & Milne-Simpson Methods 23. Multistep Methods for Special Equations of the Second Order 24. Special 2nd order equations(Contd.)	7
8. Linear Multistep Methods	25. Linear Multistep Methods 26. Linear Multistep Methods (Contd) 27. Consistency and Zero-Stability of Linear Multistep	8

	Methods	
	28. Convergence of Linear Multistep Methods	
	29. Necessary & Sufficient Conditions for Convergence	
	30. Absolute Stability and Relative Stability	
	31. General methods for finding intervals of absolute and relative stability	
	32. Some more methods for Absolute & Relative Stability	
9. Stiff-Initial Value Systems	33. First order linear systems with constant coefficient	4
	34. Stiffness and Problem of Stiffness	
	35. The problem of implicitness for Stiff systems	
	36. Linear multistep methods for Stiff systems	
10. Finite Difference Methods for Boundary Value Problems	37. Finite Difference Methods	6
	38. Analysis of Difference System	
	39. Analytic Expressionof the Error	
	40. Nonlinear second order equations	
	41. Special Boundary Value Problems	
	42. Special Boundary Value Problems(Contd)	
	Total number of lectures	**42**

References:

Lambert, J.D., Computational methods for initial value problems