NATIONAL INSTITUTE OF TECHNOLOGY, JAMSHEDPUR, JHARKHAND-831014

Department of Mathematics

Course HANDOUT for MCA, 2nd (EVEN/SPRING) Semester, 2019 Batch, Session: 2019-20

Course No.: MA3201 Credit: 4 Course Title.: Computer Oriented Numerical Techniques/ Numerical Methods

Instructor-in-charge: Dr. Hari Shankar Prasad Date: 06-01-2020

Course Description

Unit : 1

Representation of numbers: Floating point representation of numbers, Floating point arithmetic operations, normalization, pitfalls of floating point representation, error in numerical computation. Iterative methods: Zeros of algebraic and transcendental equations using Bisection method, Iteration method, Regula-Falsi method, Newton-Raphson Method. Rate of convergence of iterative methods.

Unit : 2

Simultaneous Linear Equations: Solution of System of Linear Equations, Gauss elimination method and pivoting strategy, Ill-conditioned system of equations, Refinement of solution, Gauss-Seidel iterative method, Rate of convergence.

Unit: 3

Interpolation and Approximation: Finite differences, Forward, Backward and Central difference tables. Polynomial interpolation: Newton Forward and Backward difference interpolations. Central difference formulae: Gauss Forward and Backward formula. Interpolation with unequal intervals: Lagrange's interpolations, Newton Divided difference interpolation. Linear, Quadratic and Cubic-Spline interpolation.

Unit: 4

Least square approximation: Least square approximation by polynomials and non-linear curves, Orthogonal polynomials, Gram-Schmidt orthogonalization process, Approximations of functions by Chebyshev polynomials.

Unit: 5

Numerical differentiation and integration: Numerical differentiation, Numerical Integration: Newton-Cotes Quadrature formula, Trapezoidal rule, Simpson's rules.

Unit: 6

Numerical solution of ordinary differential equations: Taylor's series method, Euler's method, Predictor Corrector method, Runge - Kutta second and fourth order methods.

Scope

To provide good fundamental concepts of numerical methods to solve scientific problems.
To make proficient in computer oriented numerical techniques.

Objective

- At the end of this course, the students will be able to understand the importance and effectiveness of computer oriented numerical methods.
- At the end of this course, the students will be able to apply the Numerical Techniques, effectively, in solving various kind of scientific problems.

Text Books

T1: Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International (P) limited, Publishers, New Delhi, 2012.

T2: Grewal, B.S. and Grewal, J.S., "Numerical Methods in Engineering and Science with Programs in Fortran 77, C & C++ ", 10th Edition, Khanna Publishers, Delhi, 2014.

Reference Books

R1: Conte S. D. & Boor, C. D., "Elementary Numerical Analysis, An Algorithmic Approach", 3rd edition, McGraw-Hill Book Company, International edition,1981.

R2: Numerical Analysis: R. L. Burden and D. J. Faires, Brooks/Cole, Cengage Learning, Boston, 9th Edi. 2011.

Course Plan

Lecture No.	Learning objectives	Topics to be covered	Refer to Chapter, See(Book)
1-3	Representation of numbers	Floating point representation of numbers, Floating point arithmetic operations, normalization, pitfalls of floating point representation, error in numerical computation. .	1(T1, R1&R2)
4-9	Solution of algebraic and transcendental equations	Zeros of algebraic and transcendental equations using Bisection method, Iteration method, Regula-Falsi method, Newton-Raphson Method. Rate of convergence of iterative methods	2(T1&T2)
10-15	Solution of Simultaneous linear equations	Solution of System of Linear Equations, Gauss elimination direct method and pivoting strategy, Ill-conditioned system of equations, Refinement of solution, Gauss-Seidel iterative method, Rate of convergence.	3(T1, T2)
16-24	Polynomial Interpolation	Finite differences, Forward, Backward and Central difference tables. Newton Forward and Backward difference interpolations. Central difference interpolation formulae: Gauss Forward and Backward formula. Interpolation with unequal intervals: Lagrange's interpolations, Newton Divided difference interpolation. Linear, Quadratic and Cubic-Spline interpolation.	4(T1), 6-7(T2)
25-31	Least square approximation	Least square approximation by polynomials and non-linear curves, Orthogonal polynomials, Gram-Schmidt orthogonalization process, Approximations of functions by Chebyshev polynomials	4(T1),5(T2)
32-37	Numerical differentiation and Integration	Numerical differentiation, Maxima and Minima of tabulated functions. Newton-Cotes Quadrature formula, Trapezoidal rule, Simpsons 1/3 rule, Simpson 3/8 rule and their error estimations.	5(T1), 8(T2)
38-44	Numerical solution of ordinary differential equations	Taylor's series method, Euler's method, Predictor Corrector method, Runge-Kutta second and fourth order methods, Stability of numerical methods.	6(T1), 10(T2),

Evaluation Scheme

ES No.	Evaluation Component	Duration	Weightage	Date &Time	Nature of the Component
1	End Sem Exam.	2 Hrs.	30%		Closed Book
2	End Sem Exam.	3 Hrs	50%		Closed Book
TEACHER ASSESSMENT					
3	Home Assignment	.....	05%		Open Book
4	Attendance	.....	05%		Open
5	Surprise Quizes/ClassTests	.....	10%		Closed Book

Chamber consultation hour: Friday: 5-6 pm

Notices: All notices regarding the course will be displayed only on the Department of the Mathematics notice board.

Instructor In-charge(MA3201)