**23MA807 ADVANCED NUMERICAL METHODS 3-1-0-4**

**Course objective:**

Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

**PROGRAM SPECIFIC OUTCOMES:** At the end of the program, the student will be able to:

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| PSO1 | Apply the knowledge of mathematical concepts in interdisciplinary fields. |
| PSO2 | Understand the nature of abstract mathematics and explore the concepts in further details. |
| PSO3 | Model the real-world problems in to mathematical equations and draw the inferences by finding appropriate solutions. |
| PSO4 | Identify challenging problems in mathematics and find appropriate solutions. |
| PSO5 | Pursue research in challenging areas of pure/applied mathematics. |
| PSO6 | Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and scientific investigations. |
| PSO7 | Continue to acquire mathematical knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematics. |
| PSO8 | Comprehend and write effective reports and design documentation related to mathematical research and literature, make effective presentations. |
| PSO9 | Qualify national level tests like NET/GATE etc. |
| PSO10 | Effectively communicate and explore ideas of mathematics for propagation of knowledge and popularization of mathematics in society. |

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| **Course Objectives:** This course is designed to introduce the basic concepts of Numerical Mathematics in order to solve the problems arising in various fields of application, for example in science, engineering and economics etc. that do not possess analytical solutions or difficult to deal with analytically. This course addresses development, analysis and application of different numerical methods to solve the problems, viz. system of linear & nonlinear equations, numerical initial and boundary value problems of ordinary differential equations etc. | |
| **Course Outcomes:** At the end of the course, the students will be able to | |
| **CO1** | Identity and analyze different types of errors encountered in numerical computing. |
| **CO2** | Apply the knowledge of Numerical Mathematics to solve problems efficiently arising in science, engineering and economics etc. |
| **CO3** | Utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics. |
| **CO4** | Design, analyze and implement of numerical methods for solving different types of problems, viz. initial and boundary value problems of ordinary differential equations etc. |
| **CO5** | Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research. |
| **CO6** | Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | √ | - | - | - | - | √ | √ |
| **CO2** | √ | - | - | - | - | - | - | - | √ | √ |
| **CO3** | √ | - | - | - | - | - | - | - | √ | √ |
| **CO4** | √ | - | - | - | - | - | - | - | √ | √ |
| **CO5** | √ | √ | - | - | - | √ | - | - | √ | √ |
| **CO6** | - | - | - | √ | - | - | - | - | √ | √ |

## Unit I

### Approximation and Errors in computing

Approximation and Errors in computing: Introduction, Significant digits, Inherent error, Rounding error, Truncation error, Absolute and relative error, Error propagation.

## Unit II

### Roots of Non-Linear Equations and solution of system of Linear Equations

Roots of Non-Linear Equations and solution of system of Linear Equations: Bisection method, False position Method, Newton-Raphson Method, fixed – point method, Muller's method for complex and multiple roots, convergence of Bisection, Newton- Raphson's and False position methods, Gauss Elimination method by pivoting, Gauss – Jordan method, Gauss – Seidel method, Relaxation method, convergence of iteration methods.

**Unit III**

**Difference Operators & Interpolation**

Difference Operators & Interpolation: Forward and Backward difference operators and table, Interpolation with equidistant point, Lagrange Interpolation Polynomial, Newton Interpolating Polynomial using divided Difference Table.

**Unit IV**

**Numerical Differentiation and Integration**

Numerical Differentiation and Integration: Differentiating continuous functions, differentiating tabulated functions, Higher order derivatives, Richardson's Extrapolation, Newton – cotes integration formula, Trapezoidal rule, Simpson's rule, Boole's rule and Weddle's rule, Romberg's Integration.

**Text Books**

B.S. Grewal, "Numerical Methods in Engineering & Science", Khanna Publication, Ed. 9th.

E. Balagurusamy , "Numerical Method", Tata McGraw Hill Publication.

S.S. Sastry, "Introductory Methods of Numerical Analysis", PHI learning Pvt. Ltd.

**Evaluation Pattern:**

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| Internal Assessment: | Midterm exam: | 1 x 30 | = 30 |
| | Quizzes, assignments, etc: | | = 20 |
| | | | 50 |
| End-semester Examination: | | | = 50 |
| | | | 100 |