**University of Management and Technology**

**Course Outline**

Course code MTH-609

Course title: **Advanced Numerical Analysis**

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| Program | PhD/MS Mathematics |
| Credit Hours | 03 |
| Duration | One Semester |
| Prerequisites |  |
| Resource Person | Dr. Muhammad Aziz-ur-Rehman |
| Counseling Timing  (Room# ) |  |
| Contact | [aziz.rehman@umt.edu.pk](mailto:aziz.rehman@umt.edu.pk), 0333-4481003 |

**Chairman/Director signature………………………………….**

**Dean’s signature…………………………… Date………………………………………….**

**Learning Objective:**

This course is a study of mathematical techniques used to model

Engineering systems. It involves the development of mathematical models

and the application of the computer to solve engineering problems using the

following computational techniques: Taylor Series approximation, numerical

differentiation, root-finding using bracketing and open methods, linear

and polynomial curve fitting, solution methods for matrix equations,

Numerical integration, and the solution of differential equations. Laboratory

sessions involve the application of numerical analysis to physical systems

involving statics, dynamics, fluid dynamics, heat transfer, electrical circuits,

and vibratory systems.

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in percentage**

Quizzes 5%

Assignments 10%

Mid Term 30%

Presentations + term paper 15%

Final exam 40%

Total 100%

**Text Books/Reference Books:**

* Numerical Analysis by Burden R L, Faires J. D
* Numerical Methods for Mathematical Science and Engineering by John. H. M
* Numerical Analysis by I. Jacques and Colin Judd
* Numerical Analysis by V. N. Vedemorthy
* Mathematical Methods for Physics: Problems and Solutions
* Farkhad G. Aliev, 2023
* Numerical Methods Fundamentals
* R.V. Dukkipati, 2023
* Numerical Analysis of Ordinary and Delay Differential Equations, T. Mitsui, 2023

**Calendar of Course contents to be covered during semester**

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| **Week** | **Course Contents** |
| 1 | Gauss Elimination Method (Partial pivoting) with algorithm. |
| 2 | Jacobi and Gauss Seidal Methods (with convergence) with algorithm. |
| 3 | Do little and croute methods, Successive over Relaxation (SOR) with algorithm. |
| 4 | Introduction to solution of nonlinear equations, Bisection method, Regula False Position Method, Secant method and their algorithms. |
| 5 | Newton-Raphson extended formula and error analysis,  Newton-Raphson Method for Multiple roots. |
| 6 | Fixed point Method with its convergence. Aitkin Method of order three. |
| 7 | Lagrange form of the interpolating polynomials, the Divided differences. |
| 8 | Difference operators and their applications, Newton’s forward Method, Newton’s Backward Method. |
| 9 | Sterling’s Method s along with their derivation. Error of Polynomial interpolation. |

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| 10 | Eigen values and eigen vectors, eigen functions, Power method, Gershgorian circle’s theorem System of nonlinear equations. |
| 11 | Interpolation: Hermite interpolation Cubic splines, |
| 12 | Numerical integration: Simpson’s Method with their error analysis Romberg Method. |
| 13 | Numerical solutions of Differential Equations: Euler’s Method, R-K Method. |
| 14 | Adam Bashforth Method, System of Differential Equations, Milnes Method (Along with their Computer programs) |
| 15 | Presentations |
| 16 | Presentations |